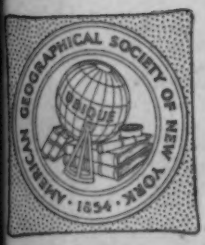
GEOGRAPHICAL REVIEW

PUBLISHED BY

THE AMERICAN GEOGRAPHICAL SOCIETY
OF NEW YORK



JULY
1937

OUR CONTRIBUTORS

DR. HALL, associate professor of geography at the University of Michigan, is director of the Institute of Far Eastern Studies, which is being held at the University of Michigan this summer. Dr. Hall's special interests lie in the Far East, though he has also engaged in field work in the West Indies. To the *Geographical Review* he has contributed the articles "Quelpart Island and Its People" (Jan., 1926) and "Some Rural Settlement Forms in Japan" (Jan., 1931).

DR. ZIMMERMAN, now professor of sociology at Harvard University, spent 1930–1931 in Siam conducting the Rural Survey for the government. In 1929, while at the University of Minnesota, he was associated with the Canadian Pioneer Belt Studies. In 1934 he served on an Advisory Commission to the President of Cuba.

PROFESSOR DEFFONTAINES, of the Facultés Catholiques of Lille, was in 1934 charged with the foundation of the chair of geography at the University of São Paulo and then the chair of human geography at the University of the Federal District at Rio de Janeiro. He is the editor of the series "Géographie humaine" (Gallimard, Paris), to which he has himself contributed the volume "L'homme et la forêt." He was also responsible for the creation of the Association of Brazilian Geographers, which publishes the journal *Geografia* (São Paulo).

DR. MOSCHELES is lecturer in human geography at the Charles University in Prague. She is especially interested in social geography and the regional geography of Central Europe. To the *Geographical Review* she contributed the article "Natural Regions of Czechoslovakia" (Oct., 1924).

MR. JOERG, formerly editor of the American Geographical Society's research publications, is now chief of the Division of Maps and Charts of The National Archives in Washington (see *Geogr. Rev.*, Vol. 27, 1937, pp. 315–317).

MR. BOGGS is geographer of the Department of State, Washington, D. C. His interest is mainly in the field of political geography, with special reference to boundaries. At the Hague Conference for the Codification of International Law, in 1930, he was technical adviser to the American delegation on the subject of territorial waters.

PROFESSOR HUDGINS is head of the department of geography and geology at Wayne University, Detroit. He has carried out various field studies in the upper St. Lawrence region and in the dune area of Indiana and Michigan and intensive studies on the St. Clair delta (see also "Human Occupance of the St. Clair Delta," *Econ. Geogr.*, Vol. 11, 1935, pp. 53–61).

DR. RAISZ is instructor in cartography and map curator at the Institute of Geographical Exploration, Harvard University. To the *Geographical Review* he contributed "The Physiographic Method of Representing Scenery on Maps" (Apr., 1931) and "The Rectangular Statistical Cartogram" (Apr., 1934).

MISS HENRY was a student in Dr. Raisz's courses.

PROFESSOR TONIOLO, formerly of the University of Pisa, is now professor of geography at the University of Bologna. He is secretary-general of the Comitato Nazionale per la Geografia. He has written extensively on shore-line processes, on climatic variations, Alpine morphology, altitudinal limits of vegetation, and mountain "depopulation."

PROFESSOR VON ENGELN teaches courses in glacial geology, geomorphology, and geography in Cornell University. His knowledge of living glaciers derives from two field seasons in glacial Alaska and observation of glaciers in the Sierra Nevada, the Alps, and Norway. By residence in central New York he has for many years been acquainted with the phenomena of Pleistocene glaciation so remarkably developed there.

THE GEOGRAPHICAL REVIEW

CONTENTS FOR JULY, 1937

PAGE

Tokaido: Road and Region 353
By Robert B. Hall

Some Phases of Land Utilization in Siam 378
By Carle C. Zimmerman

Mountain Settlement in the Central Brazilian Plateau . . 394
By Pierre Deffontaines

The Demographic, Social, and Economic Regions of Greater Prague: A Contribution to Urban Geography . . . 414
By Julie Moscheles

The Cartographical Results of Ellsworth's Trans-Antarctic Flight of 1935 430
By W. L. G. Joerg

Problems of Water-Boundary Definition: Median Lines and International Boundaries through Territorial Waters . 445
By S. Whittemore Boggs

Waterworks Intakes of the Great Lakes 457
By Bert Hudgins

An Average Slope Map of Southern New England . . . 467
By Erwin Raisz and Joyce Henry

Studies of Depopulation in the Mountains of Italy . . . 473
By A. R. Toniolo

Rock Sculpture by Glaciers: A Review 478
By O. D. von Engeln

American Geographical Society 483

Geographical Record (*listed on the next page*) 485

Geographical Reviews (*listed on the next page*) 507

The Society is not responsible for the opinions or statements of writers in the Review

PUBLISHED QUARTERLY BY THE AMERICAN GEOGRAPHICAL SOCIETY
BROADWAY AT 156TH STREET, NEW YORK, N. Y.

Price, $1.25 a number Five dollars a year

Entered as second-class matter, January 22, 1916, at the Post Office at New York, N. Y., under the Act of August 24, 1912

Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on July 30, 1918

GEOGRAPHICAL RECORD

NORTH AMERICA

The St. Clair Delta 485
Thermal Conditions in Monterey Bay. *By H. A. Marmer* 485
Recent Recession of Mendenhall Glacier, Alaska. *By Louis L. Ray* 486
The German Element in the Population of the United States. *By Richard Hartshorne* 486
A Research Program in the Soil Conservation Service 489
Geography in Recent Reports of State and Regional Planning Boards 489
A Regional-Planning Report on the Pacific Northwest. *By Edward L. Ullman* 491

SOUTH AMERICA

The High-Water Line in the Uruguay River. *By H. A. Marmer* 491
Settlement Problems of Brazil and Argentina. *By Karl J. Pelzer* 492
The Germans of Rio Grande do Sul. *By Karl J. Pelzer* 494
A Forest Reserve in Brazil 494

EUROPE

A Recent Study of Changing Tidal Channels and Coast Lines in the Netherlands. *By Jan O. M. Broek* 495

ASIA

The Boat People of Shanam 496
The Min Valley Gorge 496

AUSTRALASIA AND OCEANIA

Rice Farming in Hawaii 497

WORLD AS A WHOLE AND LARGER PARTS

Climates of South Africa and New Zealand 497
Wheat beyond the Arctic Circle. *By R. M. Fleming* 498

POLAR REGIONS

Collaboration in Glaciologic and Meteorologic Research: the Norwegian-Swedish Spitsbergen Expedition. *By John Leighly* 499

THE OCEANS

Progress in Oceanographic Research. *By Robert Cushman Murphy* 500
Oxygen in the Sea. *By H. A. Marmer* 502

MATHEMATICAL GEOGRAPHY

Daylight-Saving Time. *By Carl Hanns Pollog* 502

PHYSICAL GEOGRAPHY

Work of the International Commission of Snow. *By J. E. Church* 504

HISTORICAL GEOGRAPHY

The Development of American Cartography 505
Pegolotti's Merchants' Handbook 506

GEOGRAPHICAL REVIEWS

ALBERT ERNEST JENKS. **Pleistocene Man in Minnesota: A Fossil Homo Sapiens.** *By Kirk Bryan* 507

JOSEPH SCHAFER. **The Social History of American Agriculture.** *By Ralph H. Brown* 509

HAROLD FISHER WILSON. **The Hill Country of Northern New England: Its Social and Economic History 1790–1930.** *By Ralph H. Brown* 509

C. P. WRIGHT. **The St. Lawrence Deep Waterway: A Canadian Appraisal.** *By Richard Hartshorne* 511

CARL SCHOTT. **Landnahme und Kolonisation in Canada am Beispiel Südontarios.** *By Elisabeth Sims* 513

HOON K. LEE. **Land Utilization and Rural Economy in Korea** 514

ALBERT HERRMANN. **Historical and Commercial Atlas of China.** *By C. W. Bishop* 515

J. SIGURET, TRANSL. **Territoires et populations des confins du Yunnan.** *By Carle C. Zimmerman* 517

WILHELM CREDNER. **Siam, das Land der Tai: Eine Landeskunde auf Grund eigener Reisen und Forschungen.** *By Carle C. Zimmerman* 518

PIERRE GOUROU. **Les paysans du delta tonkinois: Étude de géographie humaine** 519

PIERRE GOUROU. **Esquisse d'une étude de l'habitation annamite dans l'Annam septentrional et central du Thanh Hoá au Binh Ðinh** 519

SHIBA PRASAD CHATTERJEE. **Le Plateau de Meghalaya (Garo-Khasi-Jaintia): Étude géographique d'une région naturelle de l'Inde.** *By A. V. Williamson* 520

S. D. PANT. **The Social Economy of the Himalayans: Based on a Survey in the Kumaon Himalayas.** *By A. V. Williamson* 520

BAILEY WILLIS. **Studies in Comparative Seismology: East African Plateaus and Rift Valleys.** *By Chester R. Longwell* 521

EDUARD REICH. **Die tschechoslowakische Landwirtschaft: Ihre Grundlagen u. ihre Organisation.** *By Samuel N. Dicken* 522

ANTON JAKHELIN. **Oceanographic Investigations in East Greenland Waters in the Summers of 1930–1932.** *By Richard Foster Flint* 522

V. CONRAD. **Die klimatologischen Elemente und ihre Abhängigkeit von terrestrischen Einflüssen.** *By John Leighly* 523

THOMAS ADAMS. **Outline of Town and City Planning: A Review of Past Efforts and Modern Aims.** *By Charles C. Colby* 524

KATHERINE MCNAMARA. **Bibliography of Planning 1928–1935: A Supplement to Manual of Planning Information, 1928, by Theodora Kimball Hubbard and Katherine McNamara.** *By Charles C. Colby* 524

V. GORDON CHILDE. **Man Makes Himself.** *By Clark Wissler* 526

DAVID BRUNT. **Weather Science for Everybody.** *By John Leighly* 527

WILLIAM HERBERT HOBBS. **Peary.** *By H. U. Sverdrup* 528

AMERICAN GEOGRAPHICAL SOCIETY PUBLICATIONS
PARTIAL LIST

A booklet describing the aims and activities of the Society may be obtained upon request

Bulletin of **the American Geographical Society, 1852–1915.** Fifty-one volumes. A set of the *Bulletin* from 1859 (complete except for four volumes that lack individual numbers), $150.00.

Index to **the Bulletin of the American Geographical Society, 1852–1915.** By ARTHUR A. BROOKS. xi and 242 pp. $2.00.

The Geographical **Review.** Successor to the *Bulletin of the American Geographical Society.* Monthly 1916–1920; quarterly since 1921. Monthly numbers, 50 cents; quarterly numbers, $1.25; unbound volumes, 1916–1920 (two a year), $2.50; from 1921 (one a year), $5.00.

Index to **the Geographical Review, Volumes I–XV, 1916–1925.** By ARTHUR A. BROOKS. 432 pp. $5.25 bound; $4.50 unbound.

Index to **the Geographical Review, Volumes XVI–XXV, 1926–1935.** By ARTHUR A. BROOKS. 373 pp. $5.25 bound; $4.50 unbound.

China: **Land of Famine.** By WALTER H. MALLORY. With a Foreword by DR. JOHN H. FINLEY. With 91 photographs and 12 maps. xvi and 199 pp. *Special Publication No. 6*, 1926. $4.00.

Problems **of Polar Research.** By 31 AUTHORS. 479 pp.; 96 maps, diagrams, and photographs. *Special Publication No. 7*, 1928. $5.00.

The Geography **of the Polar Regions.** By OTTO NORDENSKJÖLD and LUDWIG MECKING. 370 pp.; 135 maps, diagrams, and photographs. *Special Publication No. 8*, 1928. $4.00.

The Coral **Reef Problem.** By W. M. DAVIS. 596 pp.; 227 maps, diagrams, and photographs. *Special Publication No. 9*, 1928. $6.00.

Brief **History of Polar Exploration Since the Introduction of Flying.** By W. L. G. JOERG. Accompanies A Physical Map of the Arctic and a Bathymetric Map of the Antarctic, both maps in color and on scale of 1 : 20,000,000. 95 pp., 9 text maps. *Special Publication No. 11*, 2nd, revised, edition, 1930. $5.00.

Peru **from the Air.** By LIEUTENANT GEORGE R. JOHNSON. With text and notes by RAYE R. PLATT. With 142 aerial photographs and 11 maps and sketches. xii and 159 pp. *Special Publication No. 12*, 1930. $5.00.

The Pioneer **Fringe.** By ISAIAH BOWMAN. With 175 photographs, and 75 maps and diagrams. xii and 361 pp. *Special Publication No. 13*, 1931. $4.00.

Pioneer **Settlement.** By 26 AUTHORS. With 98 maps and diagrams. viii and 473 pp. *Special Publication No. 14*, 1932. $5.00.

The Grand **Coulee.** By J HARLEN BRETZ. With 37 photographs, 16 line drawings, 8 stereoscopic views, and a separate map in color. x and 89 pp. *Special Publication No. 15*, 1932. $4.00

New **England's Prospect: 1933.** By 27 AUTHORS. With 9 double page maps, 26 smaller maps and 13 diagrams. ix and 500 pp. *Special Publication No. 16*, 1933. $5.00.

The **Discovery of the Amazon According to the Account of Friar Gaspar de Carvajal and Other Documents.** As published with an introduction by JOSÉ TORIBIO MEDINA. Translated from the Spanish by BERTRAM T. LEE, edited by H. C. HEATON. xvi and 467 pp., one map and facsimiles of two documents. *Special Publication No. 17*, 1934. $5.00.

The Fiord Region of East Greenland. By LOUISE A. BOYD. With contributions by J HARLEN BRETZ, O. M. MILLER, WALTER A. WOOD, WILLIAM B. DREW, CHARLES B. HITCHCOCK, and JOHN K. WRIGHT. xii and 369 pp.; 361 halftones, 2 maps in text volume, slip case of 27 panoramas, 10 maps, and 50 echo-sounding profiles on 14 plates. *Special Publication No. 18*, 1935. $4.00.

Polish Countrysides. By LOUISE A. BOYD. With a contribution by Stanislaw Gorzuchowski. About 250 pp. 486 halftones, 9 maps. *Special Publication No. 20*, 1937.

Bering's Voyages: An Account of the Efforts of the Russians to Determine the Relation of Asia and America. By F. A. GOLDER. Vol. 1: **The Log Books and Official Reports of the First and Second Expeditions, 1725–1730 and 1733–1742.** With a chart of the second voyage, by Captain E. P. BERTHOLF. Vol. 2: G. W. **Steller's Journal of His Sea Voyage from Kamchatka to America on the Second Expedition.** Translated and edited by F. A. GOLDER and LEONHARD STEJNEGER. *Research Series Nos. 1 (1922) and 2 (1925).* $4.00.

Chile: Land and Society. By GEORGE MCCUTCHEN MCBRIDE. With 37 halftones, 14 maps, and 7 drawings, etc. 430 pp. *Research Studies No. 19*, 1936. $4.00.

The Frame of the Ancient Greek Maps: With a Discussion of the Discovery of the Sphericity of the Earth. By WILLIAM ARTHUR HEIDEL. With 1 map and 1 diagram. x and 141 pp. *Research Series No. 20*, 1937. $2.50.

Oriental Explorations and Studies, Nos. 1–6. By ALOIS MUSIL. No. 1. **The Northern Heǧâz: A Topographical Itinerary.** xii and 374 pp. 1926. $7.00; No. 2. **Arabia Deserta: A Topographical Itinerary.** xvii and 631 pp. 1927. $8.00; No. 3. **The Middle Euphrates: A Topographical Itinerary.** xv and 426 pp. 1927. $8.00; No. 4. **Palmyrena: A Topographical Itinerary.** xiv and 367 pp. 1928. $7.00; No. 5. **Northern Neǧd: A Topographical Itinerary.** xiii and 368 pp. 1928. $7.00; No. 6. **The Manners and Customs of the Rwala Bedouins.** xiv and 712 pp. 1928. Photographs, maps, drawings, and plans. $8.00.

Map of Hispanic America, 1:1,000,000 [15.78 miles to 1 inch], Provisional Edition. 77 sheets of this map have now been published. An index map to the sheets may be obtained upon request. $2.00 each sheet.

A Catalogue of Maps of Hispanic America. Vol. 1, **Maps of Mexico, Central America, and the West Indies.** xv and 287 pp. (1930); Vol. 2, **Maps of South America, Colombia, Ecuador, Peru, and Bolivia.** 254 pp. (1932); Vol. 3, **Maps of Venezuela, the Guianas, Brazil, and Paraguay.** 217 pp. (1933); Vol. 4, **Maps of the Argentine Republic, Chile, and Uruguay.** 295 pp. (1933). Each volume is illustrated with maps showing the extent and character of existing surveys. There is a general introduction by Raye R. Platt and a map in color, 1:30,000,000. $75.00 (to libraries $65.00).

The Leardo Map of the World of 1452 or 1453. Colored reproduction (measuring 28⅝ x 23¼ inches, printed on sheet 35 x 30 inches) of map in the collections of the American Geographical Society. Accompanied by volume containing text by JOHN KIRTLAND WRIGHT describing the original map and a note by A. B. HOEN on the method of reproduction, with 3 photographs and 7 maps. viii and 90 pp. *Library Series No. 4.* 1927. $15.00 ($2.00 for text alone).

Atlas of the Historical Geography of the United States. By C. O. PAULLIN. With 166 plates comprising over 620 separate maps. xiv and 145 pages; text; index. Published jointly by the American Geographical Society and the Carnegie Institution of Washington and distributed by the Society. 1932. $15.00.

Separate Maps published in the *Geographical Review* and the *Bulletin of the American Geographical Society*. 25 cents each. A list will be sent upon request.

THE
GEOGRAPHICAL REVIEW

VOL. XXVII JULY, 1937 No. 3

TOKAIDO: ROAD AND REGION*

Robert B. Hall
University of Michigan

IT is not far between barriers, since 53 stations are all of our country," wrote the Japanese poet Sankoku. The 53 stations are the post stations of the Tokaido, or "The Road" as it was often called in Tokugawa days. That was the time of the flowering of the ancient road system of Japan—the seventeenth, eighteenth, and early nineteenth centuries. The Tokaido, the greatest road of all, connected the feudal capital at Yedo (Tokyo) and imperial Kyoto (Fig. 5). Along it traveled the colorful processions of the great daimyo on their compulsory periodic visits of homage to the Shogun (Fig. 4). Along it trod countless pilgrims bound for the great shrine of Ise. On it merchants and beggars swarmed for a livelihood. An early English voyager to Japan, Captain John Saris, found the road in 1613 to be "exceedingly traulled, full of people."[1] Kaempfer, who traveled in the Dutch ambassadorial train in 1691 confirmed that opinion, finding the Tokaido "upon some days more crowded than the publick streets in any [of] the most populous towns in Europe."[2] Hiroshige, the most popular of the color-print artists, did more than twenty complete sets of pictures of the Tokaido's 53 stations; and a vivid record they are of life and adventure on the road—toilsome ascents and descents of the high passes (Figs. 2 and 3), bridges and broad unbridged streams (Fig. 1), ferry boats and relays of horses, busy inns, and snow-blanketed villages, great ladies traveling in state, and dispatch runners—the

*The writer is indebted to the Social Science Research Council and to the Faculty Research Fund of the University of Michigan for financial assistance given on the several field seasons spent in Japan during which the data included in this and other articles were gathered. To Professor Akira Watanabe of the Imperial Military Academy, Mr. S. Inoue, the staff of the Geographical Institute of Tokyo Imperial University, the town and village officials of each of the Tokaido 53 stations, and to the many other persons who gave him every assistance and courtesy within their control he is most thankful.

[1] Sir E. M. Satow, edit.: The Voyage of Captain John Saris to Japan, 1613. *Hakluyt Soc. Publs. Ser. 2, No. 5*, London, 1900.

[2] Engelbert Kaempfer: A History of Japan, 1690–1692, translated by J. G. Scheuchzer, Glasgow, 1906, Vol. 2, p. 330. Of the accounts of western travelers in Tokugawa Japan that of Kaempfer is the most exact and detailed concerning the roads.

Copyright, 1937, by the American Geographical Society of New York

Fig. 1—Daimyo's train crossing the River Oi in Tokugawa time. From a color print by Hiroshige.
Fig. 2—The old post station at Shono. From a color print by Hiroshige.

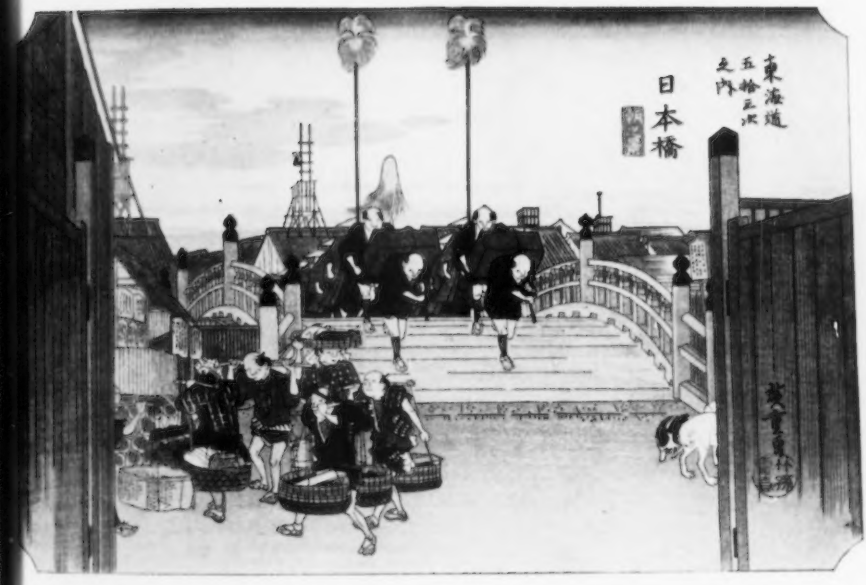


Fig. 3—The Satta Pass and Fuji. From a color print by Hiroshige.

Fig. 4—Daimyo's train crossing the Nihon-bashi, the "Bridge of Japan," at Yedo (Tokyo), starting point of the Tokaido. An early morning scene. From a color print by Hiroshige.

road in all aspects and in all weathers. Hokusai, Shigenobu, Sadahide, Toyokuni, and other famous artists also made the pilgrimage over the Tokaido. Over it traveled Japan's most popular author of Tokugawa time, Ikku Jippensha, who used the road and its 53 stations for the setting of his still popular work "Hizakurige." In fact, the

FIG. 5—The old roads of Japan: related railroads of today are also shown. Scale of map 1:32,000,000.

The inset shows the regions of Japan as defined by the Taikwa or Great Reform Edict of A. D. 646 and by the Taiho or Great Treasure Code of A. D. 701. 1, Go-Kinai or "Five Home Provinces"; 2, Tokaido or "East Sea Circuit"; 3, Tosando or "East of the Mountain Circuit"; 4, Hokurokudo or "North Land Circuit"; 5, Sanindo or "Shady (Northern) Side of the Mountain Circuit"; 6, Sanyodo or "Sunny (Southern) Side of the Mountain Circuit"; 7, Saikaido or "West Sea Circuit"; 8, Nankaido or "South Sea Circuit."

ambition of every Japanese in those days was to travel the Tokaido.

Considering the fame and importance of this great feudal road it may seem strange that so little exact knowledge about it is available. This can only be explained through the sudden loss of interest in "Old Japan" that followed the Restoration and the destruction that was a part of the period. Every Japanese has a fund of traditions of the old Tokaido, but few have any basis in fact.

THE ROAD IN EARLY DAYS

From remotest times down to the present the concepts of road and region have been closely identified by the people of Japan. In the earliest records, the eighth-century Kojiki and Nihon-shoki, we find the character pronounced *michi*, *ji*, or *do* used indiscriminately for road, circuit, province, group of provinces, and region.[3] In a country

[3] *Michi* is the older Japanese pronunciation and is now more commonly used for roadway, "the way," etc. *Do* is an adopted Chinese pronunciation and is at present used ordinarily for road or region. *Ji* is still used, on occasion, for the road to Ise. Chamberlain believed that the double concept of road and region was adopted from Korea. See C. H. Chamberlain: Kojiki, 2nd edit., Kobe, 1932, p. 216, note 2. The term *do* (*to*) is used for province in Korea today. Motowori, Norinaga, and others state that the concept of circuit, province, etc. became attached to the concept of road because of the routes of imperial officers to their posts and duties. However, the identical and earlier use of *tao* in China argues strongly for a Chinese origin either directly or by way of Korea.

as mountainous as Japan this is a logical development. Natural routes are few, and the great roads were largely determined by geography and have followed much the same courses down through the centuries, changing only in detail with the demands of a changing economic order. Like great rivers, these highways were fed by tributary roads and trails, coördinating the whole region. In this ancient Japan, where culture variation is so dominant a factor in areal differentiation, the great roads have played an all-important part in unifying and molding the regionality of the lands they serve.

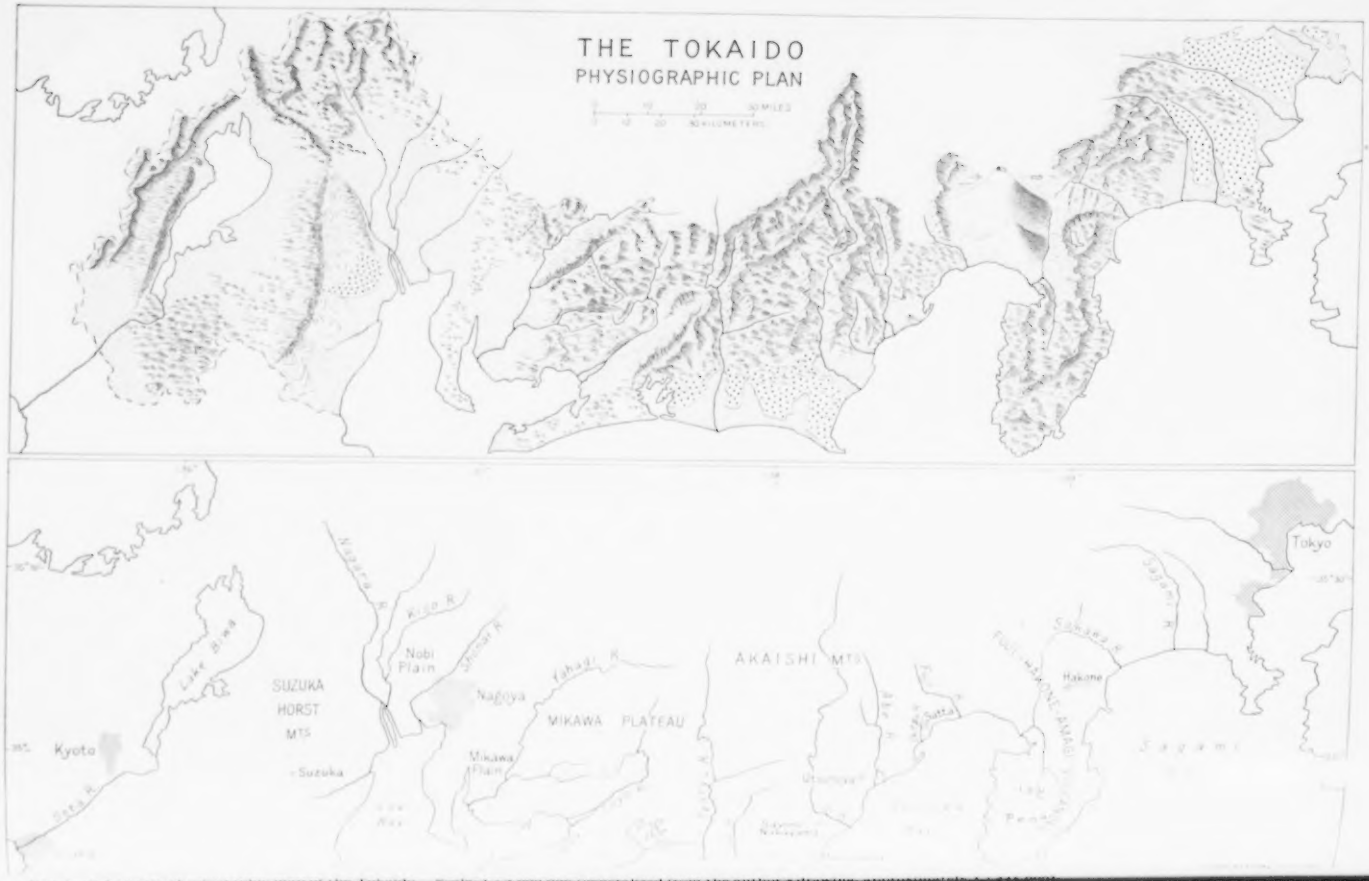
If we may judge from the campaigns of the "Shi-do Shogun," or the "Generalissimo of the Four Circuits," at least four great regions were recognized near the dawn of the Christian era, one of them the region soon to be known as the Tokaido, "East Sea Region." From the annals of early travel[4] and from the numerous ancient place names bearing the suffix "zu" or "tsu" (ferry) we may assume that there was no convenient or continuous land route through this region in Yamato time; but from the several known land points the Tokai road can be reconstructed approximately. By the seventh century, an eightfold regional division was recognized in which the Tokaido was delimited, much as it is today. By the Great Reform of A. D. 646 these eight geographical regions were divided into provinces, and through each region was built a great national highway. The unity of road and region was legalized and permanently established in the national structure.[5]

The Tokai region is geomorphologically complex (Fig. 6);[6] every road that has served it has perforce followed a circuitous route. Most difficult of the land barriers is the Fuji-Amagi volcanic land that extends southward into the Izu Peninsula. Just south of the Fuji and Abe Rivers, respectively, two spurs of the Akaishi Mountains extend to the sea. Beyond the River Oi, the great uplifted delta of Makinohara cuts across the lowland. Between Ise Bay and Lake Biwa the high Suzuka horst lies at right angles to the direction of travel. Each of these uplands is crossed by historic passes, and each has persisted through the centuries as a political boundary and a cultural

[4] The four regions invaded by the "Shi-do Shogun," according to the Nihon-shoki, Vol. 5, were: (1) Hokurokudo (Kumuga-no-michi), (2) Tokaido (Umietsy-michi), (3) Saikaido (Nishi-no-michi), and (4) Sanindo (Taniwa or Tamba). This event is not defensible as sober history. Yet the story proves the recognition of these regions at an early date. Much the same attitude may be taken as to the early travels of Prince Yamatodake and others related in the Kojiki and Nihon-shoki.

[5] The Great Reform terminated in the Code of Taiho, A. D. 702. The construction of post roads to serve the great regions this started was modeled closely on the T'ang system of the then contemporary China. A recent study, of considerable value, of the relations between the T'ang system and the Japanese "Eki Ro" of the Great Reform, is to be found in Taro Sakamoto: A Study of the Ancient Post System, Tokyo, 1928 (in Japanese). An interesting study of the T'ang post system as it operated in China is Ch'en Yüanyüan: A Study of the Postal System in the T'ang Dynasty, *Yenching Ann. of Hist. Studies*, Vol. 1, No. 5, Peiping, 1933, pp. 61–93 (in Chinese). A general but valuable statement in English is found in "Means of Communication in Ancient China." *Chinese Econ. Journ.*, Vol. 1, 1927, pp. 701–710.

[6] R. B. Hall and Akira Watanabe: Landforms of Japan, *Papers Michigan Acad. of Sci., Arts and Letters*, Vol. 18, 1933, pp. 157–207.



ROAD AND STAGES
LATE TOKUGAWA

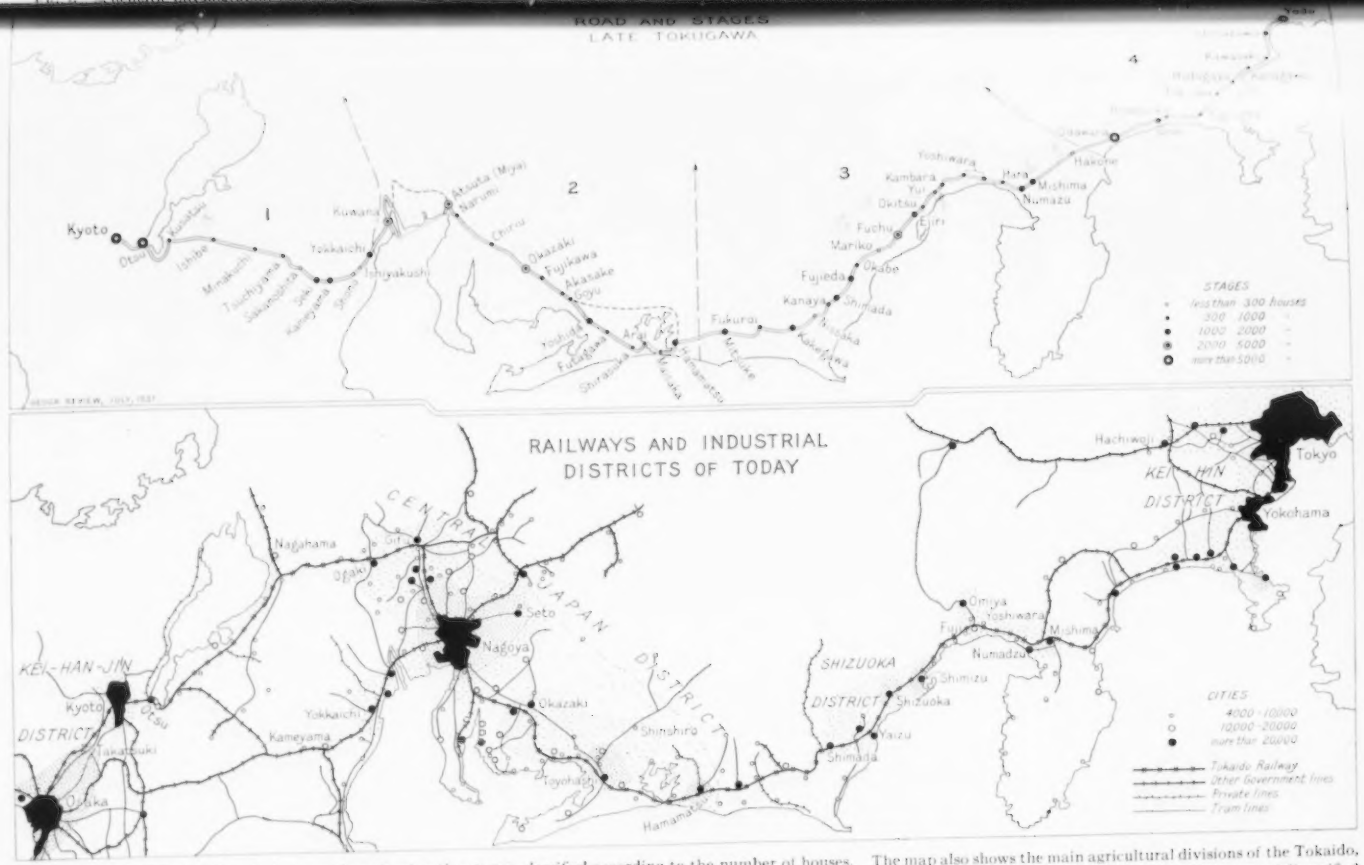


FIG. 8—The Tokaido in late Tokugawa time showing the stages, classified according to the number of houses. The map also shows the main agricultural divisions of the Tokaido, which correspond closely with the general cultural divisions of feudal days: 1, Kinai lands of very ancient cultivation, rice preponderant; 2, the modern *takakuleki* or area of diversified agriculture; 3, tree culture (oranges, tea, pears); 4, largely dry-field agriculture, today in truck gardens for the urban market.

FIG. 9—Industrial areas, chief towns, and railroad transportation in Tokaido today.

divide. About midway along the coast of Tokaido is Lake Hamana, which in ancient days was landlocked. A series of earthquakes and great tidal waves opened it to the sea, and for centuries it has formed a serious barrier. Many torrential streams, large and small, cut through the region to the sea. Of these, the Oi and Abe have proved the most difficult to cross. The great rivers of the Nobi Plain have caused all roads to deviate or traverse the sea route.

Until the northward course of empire made possible the foundation of the Kamakura capital in the late twelfth century, the main road of Japan connected the ancient imperial capitals with Dazaifu in northern Kyushu. The critical areas then bordered the Inland Sea. With the foundation of Kamakura (a few miles south of Yokohama) began that long period of dual governments that maintained capitals at each end of the Tokaido and insured the preëminence of both road and region. The condition of the Tokai road and the regionality of the area that it served have varied in direct proportion to the strength of the central government. When it was strong, the road became a national highway, and the region was closely bound to it. Sectionalism then declined, and the cultural development of the region tended to uniformity. Such was the case in early Heian time (after A. D. 794), during much of the Kamakura period (after 1186), and in the Tokugawa period (after 1603). In each period Chinese roads and political and social organizations became the model for Japanese development. The period of the last six decades, on the other hand, has taken the Occidental model as its guide. The intervening periods of weak central governments and strong local lords led to road and regional disintegration. Each provincial ruler established barriers at the frontiers of his territory and strove toward the development of provincial self-sufficiency. The Tokaido ceased to be a national highway and became in fact a series of local roads meeting at the closely guarded frontiers. Local differences developed in dialect, custom, and culture landscape. Such was the condition in Yamato time, the later Fujiwara period (the eleventh and most of the twelfth century), and from the Ashikaga to the Tokugawa period (especially the fifteenth and the sixteenth centuries). Limits of the feudal territories shifted with the fortunes of the war lords involved, and the stamp of sectionalism was somewhat modified.

The Golden Age of the Road

For the origins of the roads of Tokugawa time[7] we must go back to the great patriot Toyotomi, who, in 1572, sent messengers to all the provinces ordering reconstruction of the great roads. The width of

[7] A number of studies of the Tokugawa road system have appeared in recent years. Two particularly have proved of value to the writer. Sekko Higuchi: Communication in Tokugawa Time. Tokyo, 1931. and Ryoichi Furuta: The Communication System of the Edo Period (Swanami Lectures in Japanese History). Tokyo, 1934 (both in Japanese).

the roads was to vary from 12 to 21 feet according to their importance; stone markers were to be set up at every "ri" (2.45 miles); trees were to be planted along each side of the highway; bridges were to be built across all streams; all provincial barriers of the old regime were to be removed and every facility provided for travel and trade. However,

FIG. 10

FIG. 11

FIG. 10—One of the few still existing "one ri" markers on the Tokaido.
FIG. 11—The *kago*, the means of transport for officials and ladies in ancient Japan.

not until the Tokugawa government was well established at Yedo was the plan perfected. From the Bukke-Sho-Hatto (1635) we learn that "Roads, relays of post horses, boats, ferries, and bridges must be attended to—no private toll barriers are to be erected and no existing ferry discontinued." Five main roads were constructed. Like the great roads of Rome, which all began at the Forum, all these began at Nihon-bashi, "The Bridge of Japan," in the center of Yedo. Distances in the Empire were computed from this point and accurately set off by milestones—a practice that still persists.

Of all roads Tokaido (Fig. 8) was the greatest. Between Yedo and Kyoto it extended for 300 miles. Its width was regulated at 36 feet.

On each side was an embankment 3 feet high and 4 feet wide. Beyond the embankments strips of land 36 feet wide were set aside for the care of the road. What the actual condition was at the height of Tokugawa power is not known, but my own measurements of roads show an average width of less than 18 feet, being as much as 21 feet near the great towns and less than 15 feet at more distant points. The sup-

FIG. 12—The barrier at Hakone stood at the neck of the peninsula to the right. Hakone town in the foreground.

porting strips of land long ago reverted to private ownership. Trees were planted along all the embankments—cryptomerias on granitic lands, red pines near the sea, and black pines generally in the interior. At every "ri" mounds of earth were piled on each side of the road, 9 feet high and 15 feet in diameter, and planted with Chinese nettle trees. Guide stones were set up at every crossroad.

Gutters were provided for drainage either at the sides or in the center of the road. Often mountain streams were deflected into them for the refreshment of men and horses. The roadbed was laid deep with beaten gravel and covered with sand, except on slopes that were steep and subject to erosion, where it was paved with stone. There is little doubt that, for its period, no road in the world equaled the Tokaido. Saris noted: "The way for the most part is wonderfull even, and where it meeteth with mountains passage is cut through." Thunberg, in 1796, declared "The roads in this country are broad—and in good order all the year round." "I found the road the most clean in the world," wrote Rodrigo. Siebolt in 1826 observed that no other roads were so well built and maintained.

The daimyo of Japan contributed toward the upkeep of the Tokaido according to their rice income. Those whose fiefs were served directly by it were the most heavily taxed. Locally the feudal lord taxed the people for the support of the road, both in money and in labor.

Transportation in Tokugawa time was confined largely to foot and horse. Wheeled vehicles were limited to short cargo hauls on the main

FIG. 13—The fine old wooden bridge of Seta (the Seta River drains Lake Biwa) is still standing.

lowlands. Two-wheeled carts were employed between Fuchu (Shizuoka) and Ejiri, about Shinagawa, and in the rice trade at Otsu. When on the road daimyo, fine ladies, rich merchants, and high officials traveled by *hako-kago*, or enclosed palanquin. A few others afforded the cheaper *yama-kago*, or hard, open palanquin. Samurai traveled by horse or on foot. Lesser officials and some others also employed horses. The great bulk of the travelers, however, went entirely on foot. The *jinrikisha*, or *kuruma*, did not reach Japan until the Restoration. The first to be used at Shizuoka, for example, was in the fifth year of Meiji (1873).

Barring accident or delay, the trip from Yedo to Kyoto could be made in about twelve days (an average of 25 miles a day). The shortest trip on record was that of the vassal of Ako who carried the message from Yedo to Ako castle telling of the incidents that led to the vendetta of the "Forty-seven Ronin." This messenger left Yedo on March 15 and arrived at Ako on March 19, so that he must have traversed the entire length of the Tokaido in a little more than three days. He, of course, traveled night and day, frequently changing carriers. Most travelers regulated their journey to clear the great natural barriers

by full daylight and to satisfy their personal interest, whether it were the temples of Mishima, the famous views of Fujisan, the garden of Hara, or the licensed district of Okazaki. The traveler also planned to avoid spending his nights where police jurisdiction was too strict or at castle towns where swaggering samurai were too numerous.

FIG. 14—Images along the old roads still are impressive.

The Tokugawa road traversed the Hakone and Suzuka Passes, as well as the lesser passes of Satta and Utsunoya. All but the largest rivers were bridged or could be easily forded or crossed by ferries. The Oi and the Abe, however, remained as great adventures, and the traveler was compelled to hire porters to carry him across. The Oi, on occasion, was impassable for as much as a month.[8] Ferries were also employed across the neck of Lake Hamana and across the head of Ise Bay. To these natural barriers were added official ones. Hakone was further strengthened as a defense for Yedo by the establishment of a strong police post and barrier (Fig. 12). Strict rules were enforced to assure that no guns were brought into Yedo and that no women hostages escaped. A second great police barrier was established at Arai, where the ferry landed after crossing "Imagire." Unofficial yet effective inspection stations were established at points such as Atsuta, which the traveler found difficult to avoid and which were under direct Tokugawa control.

Parallel though longer roads developed to the ferry routes of the official highway. Illegal use of the Hime Kaido or "Woman's Road" north of Lake Hamana caused the government to build a small barrier at Kega. North of the Atsuta-Kuwana ferry and around the head of the Nobi Plain a similar land road, the "Saya" way, came into being. The official road crossed the great bridge of Seta just south of Lake Biwa (Fig. 13).

In competition with the Tokaido was the Nakasendo or "Central Mountain Road," which also connected Yedo and Kyoto.[9] The strategic value of this inner longer and more difficult road has been

[8] A famous old proverb ("Hakone hachiri wa womade mo Kosuga Kosuni kosarenu Oigawa") has it that "difficult as is the crossing of the eight *ri* of Hakone's mountain, it yet can be made on horseback, but not so the crossing of the Oigawa."

[9] J. J. Rein: Der Nakasendô in Japan, *Ergänzungsheft No. 59 zu Petermanns Mitt.*, 1880.

recognized by all governments, and it has been consistently maintained. In Tokugawa days it was used by travelers when the Tokaido rivers were in flood. It was traveled by many for variety's sake alone and for the great temples, shrines, and scenic views along its course. Imperial envoys were compelled to alternate the two great roads. Also in competition with the Tokaido was the East Sea route. Practically

FIG. 15—Fishing boats today use the old barrier landing at Arai.

all bulky cargo was shipped by sea. The tax rice was by far the most important item in this trade. Few commodity shipments went by the Tokai road: its function was chiefly that of travel and communication.

In theory the stations of the Tokaido were to be about ten miles apart; but, because of the difficulty of travel in the mountainous country, the necessity for stations on each side of the great unbridged rivers, and the fact that the smaller and poorer stations proved incapable of accommodating heavy traffic, the total grew until the average distance between stations was but five and one half miles. These stations were called *shuku ba* or post stations. Between them were established *aino shuku* or middle stages (Fig. 16). In addition *chaya*, or tea houses, grew up at frequent intervals. In fact, practically every village and every house on the great road catered to the needs or desires of travelers.

The 53 stage towns had several features in common. The stage proper, defined by right-angle jogs, was generally strung along a single street whether in the open country or as part of a greater town. At convenient central locations shaded walks led from the road to a sheltered temple or shrine. This village form arose, not as a means of defense, as has been stated, but rather as a face-saving device. The feudal lords on their frequent pilgrimages dispatched runners ahead to report the coming of other feudal lords. If a meeting occurred between two daimyo, the lesser one had to dismount and do obeisance

before the greater. Hence the right-angled turns were screens and the temples and shrines excuses for convenient rest and prayers. Many of the middle stages had this same arrangement.

Each post stage had a central office, stables, and a porter station and quarters. The average stage had one porter station that provided 100 horses with porter attendants and 100 pack porters. But at Seki, for example, two porter stations and 150 horses and 150 porters were necessary for crossing the Suzuka horst. Arai and Misaka, at the ferry of "Imagire," provided neither horses nor porters. Hakone had 100 horses but no porters, because of the problem of food at this high mountain barrier. At the great rivers porter stations were established on each bank and special porters were available. For the crossing of the Oigawa 700 porters served each station.

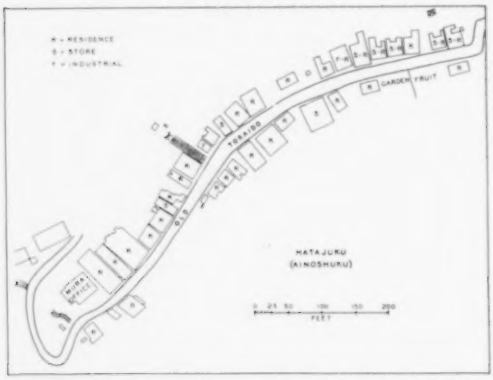


FIG. 16—Plan of a middle stage, *aino shuku*, on the Tokaido. Note the right-angled jogs in the road.

In each stage there was at least one *honjin* (great hotel) for the accommodation of daimyo. This was the largest and finest building in the town. It had a great gate at the entrance and fine gardens and general accommodations within. Each stage had one or more *waki-honjin* (large hotels) for samurai and officials and a considerable number of official *yadoya* (inns), and all houses took guests when traffic was heavy. Mishima with its great shrines and temples had 200 registered inns. Seki had about 100 to accommodate traffic over Suzuka Pass. Most stages had about fifty. In addition, there were an untold number of *mokuchin*, the feudal term for the modern flophouse, which accommodated coolies and porters. Practically all inns kept women, geisha and prostitutes, and there were large licensed quarters in many of the stages. Especially was this the case in the vicinity of the great shrines, Atsuta, Mishima, and Mitsuke. There were also numerous attendants at the tea and rest houses and waitresses and maids at the inns. The result was that in most stage towns the female population exceeded the male.

The average stage proper had about 300 houses; in the poorer areas as few as 125 to 150 houses made up the settlement; at the more important stages 500 to 600. It is interesting to note that Kaempfer, unused to Japanese densities, underestimated the size of most of the

53 Tokaido stations by about half. The inhabitants served in several capacities. Most of the men worked, at least part of the time, as porters; and they were also farmers or fishermen as the location of the stage determined. Some product or other, medicine, straw sandals,

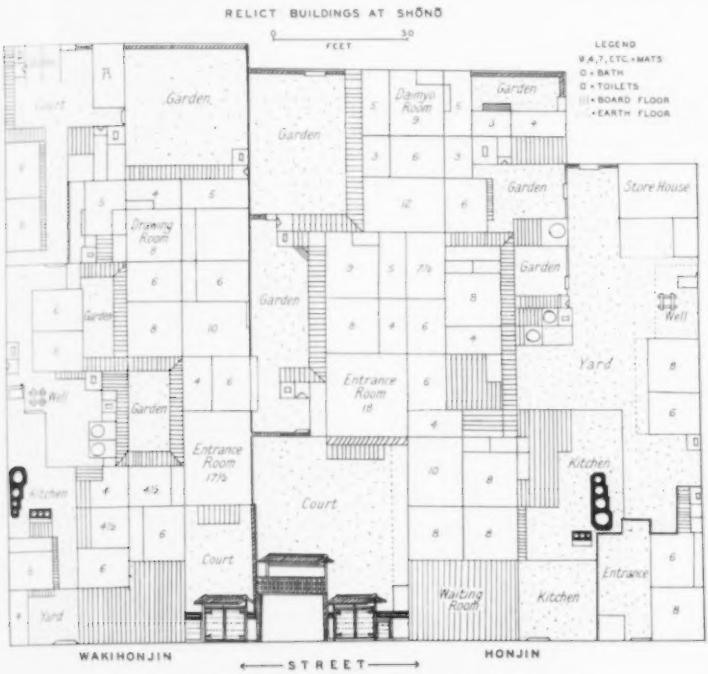


FIG. 17—Plan of ancient hostelry buildings on the Tokaido

cakes, or bamboo work, was made in the home; and the children hawked the articles to passing travelers. Practically every stage was famous for one or more of such articles—black medicine at Kanagawa, "twopenny cakes" at Fujisawa, fish paste at Okitsu, and woodwork at Hakone. Many of these household industries have formed the basis for large modern industries.

At or near the center of every stage was the notice-board square. Here wooden signposts informed the traveler as to the laws and charges of the station and the moral code of the government (virtually the ten commandments). Another board prohibited Christianity and offered rewards for the apprehension of priest or convert. Frequently the reward—a lump of gold or silver—was nailed to the signboard. At both entrances to the stage were high poles bearing notices of the time of arrival of expected daimyo.

Many stage towns, in addition to their general structure, had special features. At Shinagawa, Fuchu (Shizuoka), and Kusatsu

were found offices of *kwamme-aratamejo* (weight and measure inspection) where loads carried by men and horses were checked to see that they did not violate national regulations. In many stations were offices known as *shichirisama* (honorable seven *ri*) where great daimyo maintained their own postal service. Execution grounds, usually

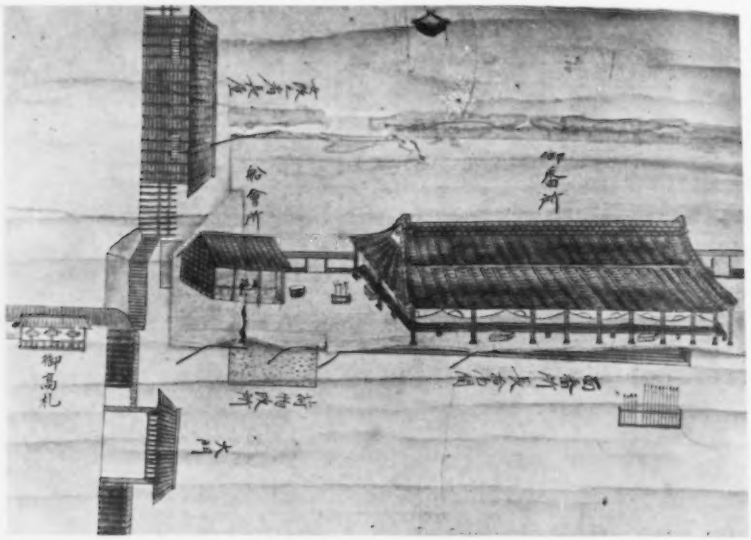


FIG. 18.—The barrier at Arai in Tokugawa time. The bulletin boards just outside the great gate are of the type used throughout the Tokaido to inform travelers of laws, charges, and awards and to give moral advice.

just outside the town at the west end, were the unpleasant features of some stages. These reservations lie idle today.

In addition to town shrines and temples there were many wayside shrines. At dangerous passes, where the road ran through dark woodland or where it traversed lonely and desolate land, images were erected—usually of stone, sometimes of bronze. These were most commonly of Jizo, the protector of the traveler or of Kwannon, the goddess of mercy.

Beside the natural relation between the Tokai road and its economic domain, the Tokai region, certain policies of the Tokugawa government made this relationship even more intimate. Because its location was so critical the fiefs of the region were held by relatives or by hereditary vassals. These men were all of a mind with the central government and developed their domains according to national policy. Fuchu, now Shizuoka, and Hamamatsu castles had no feudal lords but were ruled directly by agents of the central government. There was nearly complete political unity throughout the Tokai region. The post stations of the road were for the most part *tenryo* or "heavenly

domain." They were controlled directly by the central government. Some were ruled by the nearest feudal lord, and strategic Hakone was half under the national control and half under the Odawara daimyo.

Another strong unifying force was the system known as *sukego*. When one realizes that the trains of the great daimyo on their periodic pilgrimages to Yedo included thousands of men, large numbers of horses, and great quantities of goods, it is readily understood why the regular quota of porters and horses at the stage towns often proved inadequate. To meet this condition the villages adjacent to the post station were organized and compelled to furnish horses and men on demand. Attached to Mishima were 128 villages. In many small stations all villages within five miles were attached. The larger stations drew from still wider areas. Mishima drew its *jo-sukego* or "large demand" from eastern Suruga Province and the Izu Peninsula and its *ka-sukego*, or "small demand," from the province of Kai. Yui and Fuchu, I believe, were the only exceptions. Yui had 11 so-called associated villages, and Shizuoka had no part in the system. This system did much to integrate all settlement in the region with the road. Of it, Professor Honjo says that after it gradually spread throughout the domain of the road it began to weigh heavily on the villagers and "it is obvious that this *sukego* system interfered with farming and caused land to go to waste and the farmers to become impoverished in many cases."[10]

Powerful as were the forces for homogeneity, the great natural barriers that divided the region and the preceding centuries of local development allowed cultural subdivisions to persist. These were: the Kinai section from Kyoto to the great rivers of the Nobi Plain; from Nobi to "Imagire," the neck of Lake Hamana; from "Imagire" to the Hakone Pass; and from Hakone to Yedo. Each subdivision had its distinct dialect. "Imagire" was so distinct a line that no marriages ever took place across it. Architectural styles change abruptly at the Nobi rivers. Hakone marks the still apparent division of eastern Japan into Kwanto and Kwansai.

Other local differences were brought about by differences in agricultural and industrial development. The tea of the valley of the Oigawa was second only to the teas of Uji. Oranges on the hills of Suruga were nearly as famous as those of Kii. Until prohibited by the present government, salt from the coast of Suruga Bay supported many villages. Cherry shrimps and a kind of bandfish found their way from Tokaido shores to Yedo markets. *Nori* (seaweed), from the shores of Tokyo Bay, and timber that was floated down the Kiso River supported thriving industries. Cotton cloth was made by hundreds of families living toward the western end of the region. Silk from Toyohashi was as important then as now. *Seto* potteries from around Nagoya

[10] Eijiro Honjo: The Social and Economic History of Japan, Kyoto, 1935, p. 242.

were famous, as were lacquer from Fuchu and bamboo work from Kusatsu. On a grander scale most of these industries persist today.

Tokaido Since the Restoration

The Tokugawa cycle closed in 1867 with the collapse of the old government. The Restoration marked the beginning of a new era.

Fig. 19

Fig. 20

Fig. 19—A largely unaltered section of the Tokaido on the outskirts of Shimizu.
Fig. 20—An abandoned section of the Tokugawa Tokaido near Hakone.

In previous great revivals the road and the economic and political systems were of the old Orient. This revival, however, was conditioned by the industrialized Occident. With the new government came the power transportation, the engineering methods, the markets, the products, and the nationalism of a new world. Tokyo and the Kinai ports became the gateways of this new culture so that the Tokai region was flooded from both ends simultaneously, and its transformation has been rapid. Not until 1889, however, was Japan's main-line railroad, the Tokaido, completed in its 329 miles from Tokyo to Kyoto.

The original trajectory of the Tokaido Railway followed the older and easier route of Ashigara rather than over Hakone Pass. In 1935, however, after years of work, the loss of thousands of lives, and the expenditure of far more millions of yen than had been originally estimated for the project, the Tanna Tunnel was completed. This tunnel, one of the longest in the world, cuts under the Fuji-Amagi

FIG. 21

FIG. 22

FIG. 21—Where a new route has been chosen for motor traffic the old Tokaido remains unaltered. Near Shimizu.

FIG. 22—Looking down upon Kanaya from the top of Makinohara. The old and new Tokaido join in the foreground.

volcanic mass at the narrow neck of the Izu Peninsula. Now it is possible to make the trip from Tokyo to Kyoto in seven hours. The problem of Satta Pass was solved by Satta Tunnel. A motor highway now follows a wall-enclosed concrete platform seaward around the headland. Steel and concrete bridges cross the Oi, the Abe, and other rivers of Tokaido, and a similar crossing is provided at "Imagire." From Atsuta, however, the Tokaido Railway leaves the old road and follows the course of the ancient Mino Way to the famous pass of Sekigahara where it turns southward along the Biwa Plain and crosses

the southern tip of Lake Biwa by a new bridge over the Seto. This is almost the identical trajectory of the Tokaido of Heian time. Along other parts of the route the old Tokai road and the new one run side by side, departing for short distances here and there so that the railroad can take advantage of easier grades or more direct river crossings.

From the Restoration in 1868 until the completion of the railroad

FIG. 23.—The old Tokaido has been widened in its course through some of the post towns to accommodate motor traffic.

in 1889 all of the stage towns of Tokaido declined. With the abolition of the feudal system the great trains of the daimyo no longer passed. No longer did messengers and officials follow the road, because now there was but one functional capital, Tokyo. Inns disappeared or were put to other uses. Castle towns also declined because the samurai and feudal lords were compelled to seek a new life. Great disparity appeared between the old stages: those touched by the railroad soon began to prosper; the rest, with scarcely an exception, continued to decline.

Manufacturing industries have, of course, established themselves in the towns along the railroad. Many towns have grown to great cities. Shinagawa has increased from 1500 houses in feudal days to 42,000; and the Atsuta-Nagoya agglomeration from 20,000 to 209,000 houses. On the whole the castle towns have fared well. They were advantageously located and were of large size. In addition to the industrialization of the railroad towns opportunity for wide markets was offered. Arai and Maisaka have more than doubled through the development of commercial fishing. Totsuka finds urban markets in Kwanto for its surplus agricultural products. Resorting, made possible by rail transportation, has allowed the points with fine scenic and climatic advantages to prosper. At Okitsu Prince Saionji, the

last of the genro, has his villa; and politicians and others have flocked there. At Odawara Prince Yamagata and at Oiso Prince Ito started similar fashions.

The stages and substages that were missed by the railroad have all had difficulty. Those in the midst of good agricultural land have settled down to its development and a more or less self-sufficient existence. Those not so fortunately located have turned to whatever

FIG. 24—The coast of Oyashirazu below the Satta Pass with Fuji in the background.

opportunity was afforded; charcoal burning and woodworking support many mountain villages. All have sent their young men and women to the growing industrial cities on the railroad. From Minakuchi, for example, more than seventy per cent of all the people reaching a working age have migrated every year for the past three decades.

The later building of secondary railways, steam, gasoline, and electric, has helped many of the towns not on the main line. However, with hardly an exception there is an absolute correlation between the three classes of towns shown and the three conditions of transportation; towns on the Tokaido Railway have grown more rapidly than has the population of Japan proper, roughly in the ratio of 7 to 3; those on secondary railways have grown but not so rapidly; and those not served by any railway have declined absolutely.

Two new forces at work in the region today are rapidly altering the disparity created by the railways. First is the construction of concrete highways and the growth of trucking. This is the new "Five Year Plan," and in characteristic Japanese manner it is proceeding at a phenomenal rate. Secondly the trend toward the decentralization of industry is developing with equal rapidity. Great modern factories are rising in the midst of the paddy fields and midway between several villages where surplus labor can be obtained.

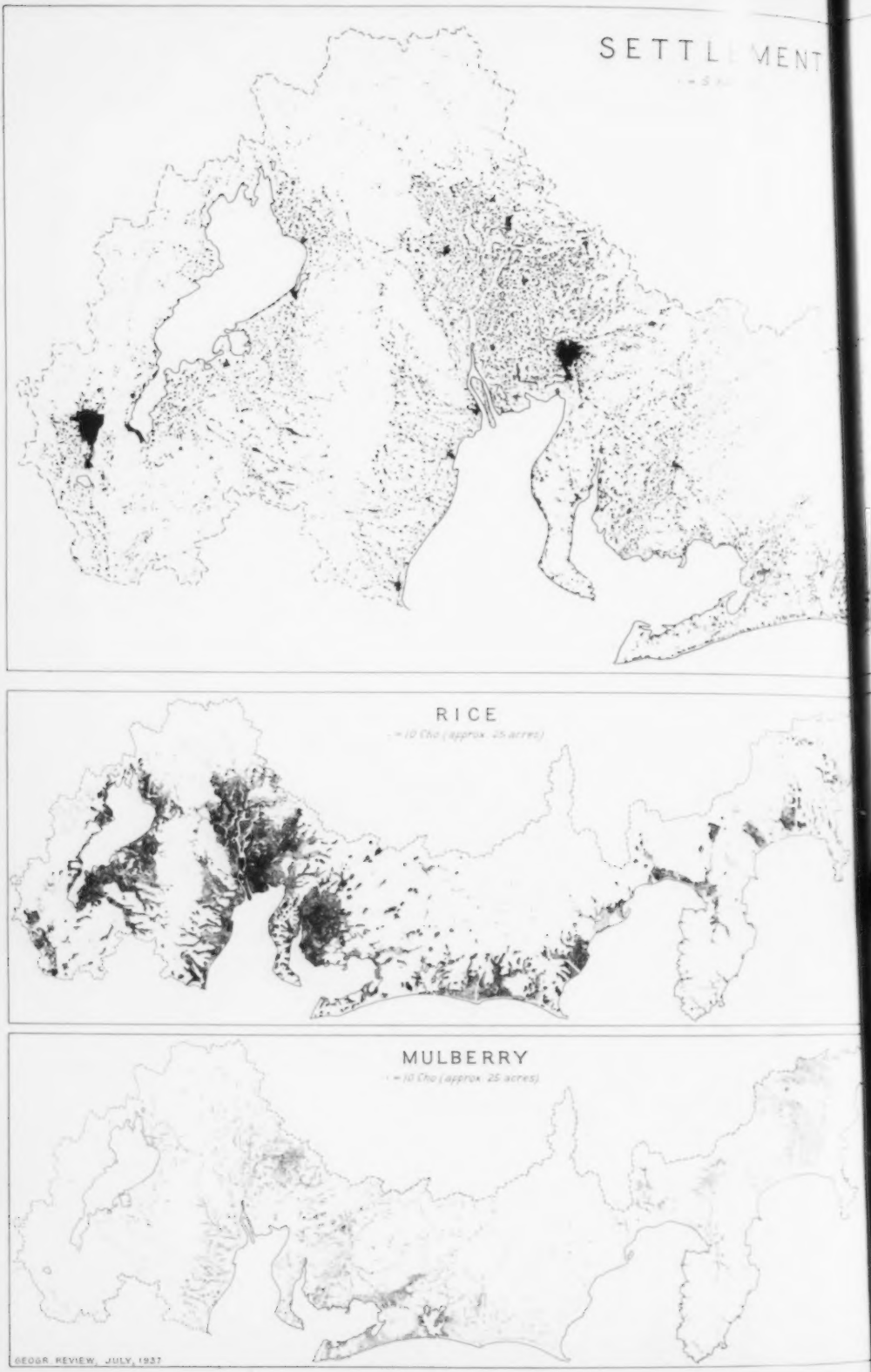


FIG. 25 (continued on facing page)—Map showing the distribution of population in the Tokai region. One dot represents five
FIG. 26—Map showing the distribution of rice cultivation in the Tokai region (compare Fig. 28). Scale of Figures 26 to 29,
FIG. 27—Map showing the distribution of mulberry cultivation.

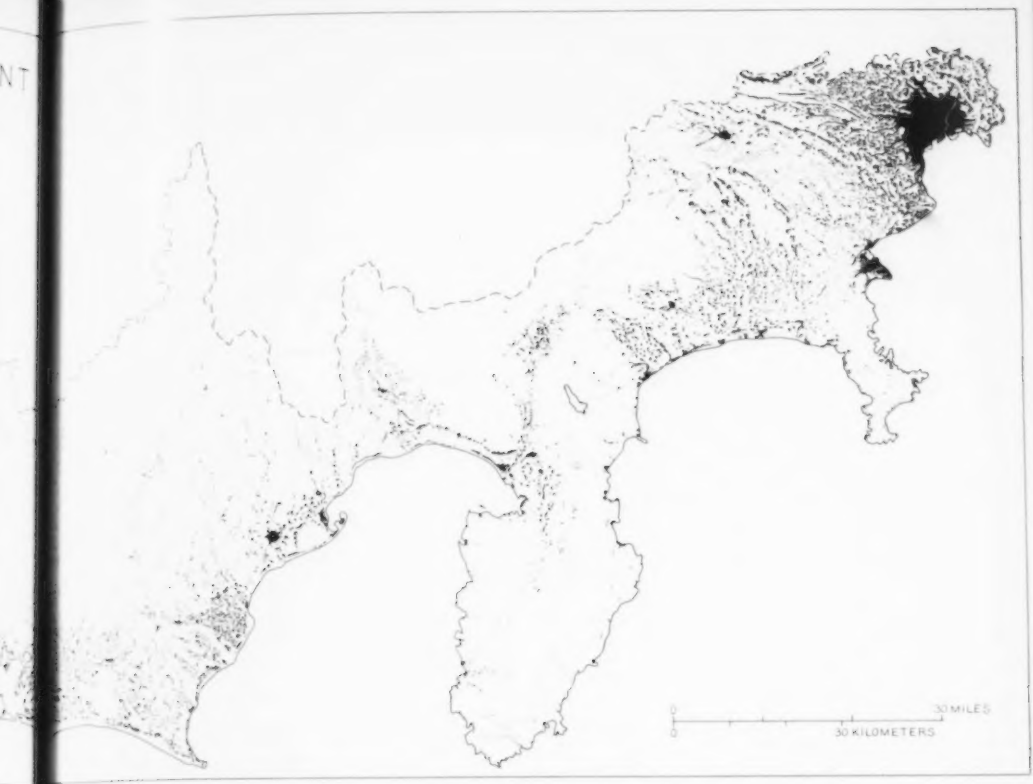


Fig. 25 (continued from facing page)—Map on the scale of 1 : 1,200,000 reduced from the author's drawing on a scale of 1 : 180,000.
Fig. 28—Map showing the proportion of arable land under rice cultivation (compare Fig. 26) in the Tokai region.
Fig. 29—Map showing the distribution of tea cultivation.

A word should be said about the alteration of the political pattern in the new era. The old provinces were abolished as were all barriers. Five *ken*, or prefectures, now comprise all the area from Kwanto to Lake Biwa; but the old natural barriers of the Hakone Mountains, Lake Hamana, the great rivers of Nobi, and the Suzuka horst still are the boundary lines between them. Within the provinces local communities have been encouraged to organize incorporated towns and cities. In these new political units we find again and again the associations of feudal days asserting themselves. Yui town today is the Yui village of old plus its eleven associated *sukego* villages.

Present-day Tokaido can be most readily understood through a consideration of its cultural subdivisions. Agriculturally four divisions are recognized (Fig. 8).The lands of Kinai are the home of the oldest agriculture and the most conservative agriculturists. Centuries ago this area was completely developed along the old lines and had passed the point of diminishing returns apparently by Tokugawa time. Rice here occupies the highest percentage of arable land. Virtually a rice economy persists. New crops and new methods have not been adopted. In general it is an area of declining rural population. The Ise Plain may be taken as representative. Today it supports a rural population of 350 to the square kilometer.

From the western edge of the Nobi Plain eastward including Lake Hamana is a district that the Japanese speak of as *Takakuteki*, or the area of polyculture. Here, too, rice is the main crop, but there are many other products. The vegetables of the Mikawa Plain are famed throughout Japan. Hothouse culture is characteristic of the plain about Hamamatsu. Pig and chicken populations are densest. Milch cows are kept on many farms. Anjo has become famous for its snake rearing. Sericulture is an important adjunct to most farming. Tree culture, however, is generally lacking. Rural population densities are increasing and now average 650 a square kilometer around Nagoya.

From Hamamatsu eastward including the Izu Peninsula is the district of tree culture. Rice is still the first crop, sericulture is not important, but the oranges, pears, and tea of this area exceed the combined productions of all other parts of Japan. Biwa (loquat in Chinese) and peaches also occupy considerable areas. Much of this tree culture is new and occupies recently reclaimed uplands. The rural population is generally increasing throughout and averages 550 to the square kilometer on the delta of the River Oi.

From Odawara to Tokyo is a district largely of dry-field agriculture, convenient to the great urban markets of Kwanto. The rice acreage is limited. Truck gardening is widely practiced. Sweet potatoes are a main crop. Kamakura and Hiratsuka hams are nationally famous. Chickens, some fruit, flowers, vegetables, dry grains, and rice are important productions. The rapid spread of suburban dwellings into

this district makes it difficult to arrive at exact figures for the agricultural population, but it would seem to be between 400 and 450 to the square kilometer in the arable portions.

These agricultural districts, it will be noted, correspond almost exactly with the dialectic and general cultural subdivisions that were apparent in feudal days, and in spite of universal education and the national dialect of today these divisions are still clearly delineated. The fishing industries add to the livelihood of the coastal dwellers.

Similarly four industrial districts are differentiated (Fig. 9), but these are separated by wide stretches of unindustrialized territory. In the northeast is the great industrial district called by the Japanese "Kei-Hin." Almost countless small factories produce small articles in great variety, chiefly for the domestic market. In the western and newer extension, including several of the Tokaido stages, are larger and more modern factories. Next westward is the Shizuoka Industrial District. Its industries are not so varied nor so concentrated as in the preceding area. Paper manufacturing and woodworking, lacquer work, fish and fruit canning, tea processing and packing, and more recently textile manufacturing characterize the area. An outlier of this district is the area between the Fuji River and Mishima. Here paper, cotton textiles, and confectionery are produced. As an industrial district the Shizuoka area is of secondary importance. Farther west is the great Central Japan Industrial District that centers about Nagoya. The cotton-cloth manufactures of Nagoya City now exceed those of any other single city in Japan, if not in the world. The wool textile industry of Nagoya accounts for more than half of Japan's growing production. The pottery industry of Nagoya and Seto is the largest in Japan and certainly one of the first in the world. The Mikawa Plain, especially about Toyohashi, is second only to Suwa in silk production. Hamamatsu is famous for its cotton cloth, dyeing, musical instruments, and heavy industries. This district is the most thriving industrial area in Japan. The western end of the old Tokaido falls within a part of the Kei-Han-Jin district. Cotton and silk cloth, machinery, chemicals, motor cars, and iron foundries are among the many great industrial products of this district. Cotton, rayon, and silk manufacturing are particularly characteristic of the Lake Biwa shores and other areas within old Tokaido.

Within the Tokai region, then, are three of the four chief industrial districts of Japan, northern Kyushu alone being excluded. It is largely the tying together and serving of these districts and their great populations that makes the Tokaido Railway the trunk line of the nation. This great railroad with its many feeder lines still binds the localities of the East Sea Circuit together as a functional unit; and, although of a more complex nature today, there exists as ever the unity of the Tokaido—road and region.

SOME PHASES OF LAND UTILIZATION IN SIAM

Carle C. Zimmerman
Harvard University

FIG. 1—Decoration on panel of bullock cart, Chiengmai, northern Siam.

Geographic regionalism is largely a matter of relativity. The world may be looked at as two or three regions or as any number of regions. We speak of the continent of Asia: what do we think of? Of the two great historic cultures, the Hindu and the Chinese? Of the masses of humanity in these greatest of human agglomerations? But their size, unwieldiness, "overpopulation," land hunger and famine, caste system, ancestor worship, war lords, and the like do not embrace the "problems" of all Asia. Setting aside the Near East as "Eurasian" rather than Asian, there are besides these two great areas of dense population two thinly populated areas, central and northern Asia and the Indo-Chinese peninsula. It is with the latter, or rather with one of its four subregions, Siam, that we are concerned.

Here is a country where, contrary to the common picture of Asia, population is not dense. What pressure there is on natural resources is largely due to archaic methods of land utilization. The Siamese are an intelligent people. They have been long engaged in developing a state in competition with external enemies on the one hand and a tropical environment on the other. If Siamese agriculture seems inefficient from our point of view it is lengths ahead of the native agriculture of most other tropical regions.[1] The frame of economic reference commonly applied to Asia as a whole does not so readily fit Siam. This is worth bearing in mind in relation to future orientations of power in Asia. If the Siamese master their own problems of internal development, they have a wonderful opportunity and a rich heritage awaiting them. From the military point of view the country is not difficult of protection. Unlike the Malay States, Java, and the Philippines, it has no great harbors; and it is rather off the beaten commercial track.[2] On the other hand, it has opportunities for production of food and cotton on a large scale; it has a livable climate and timber resources to spare; but if internal leadership does not develop these resources, the pressure of external circumstances will undoubtedly be brought to bear on them.

[1] For comparative budgetary data for families of different regions see Faith M. Williams and Carle C. Zimmerman: Studies of Family Living in the United States and Other Countries, *U. S. Dept. Agric. Misc. Publ.*, 1935; Carle C. Zimmerman: Standards of Living and Consumption, New York, 1936.

[2] If the Kra Canal should be built the outlook would be changed. See W. J. Ronan: The Kra Canal: A Suez for Japan?, *Pacific Affairs*. Vol. 9, 1936, pp. 406–415.

An analysis of the basic questions of any one of the three great river valleys (the Malay States present considerable differences) is in many respects a case study of the main body of southeastern Asia.[3]

The Indo-Chinese Peninsula

The peninsula of southeastern Asia falls roughly into four regions: the Malay subpeninsula and the regions drained primarily by three river valleys, the Irrawaddy, the Menam Chao Bhraya (hereafter called the Menam), and the Mekong. Around these three river basins are three population aggregates—the Burmese around the Irrawaddy, the Siamese around the Menam, and the Cambodian (or Indo-Chinese) around the Mekong. These, of course, are only rough distributions. The Lao, who are essentially upcountry Siamese, occupy a large part of the upper middle basin of the Mekong, and the people of the eastern coast of the peninsula are highly mixed with Chinese blood; whence by inbreeding almost separate racial groups have resulted, the Annamites and the Cochin-Chinese.

The three river basins have many elements in common. Each drains a general region at the northern part of the main peninsula inhabited by a mother stock of the chief peoples to the southward —the Shans. The Shans, roughly speaking, separate China from India in the general region of uplands drained to the south by these three rivers, to the east by the Brahmaputra, and to the northeast by the Yangtze Kiang.[4] Each valley is separated from its neighbors by a north-south series of mountain ranges and uplands. Migrations of race and culture, once the groups separated from the common mother stock of the Shans, have been to the south. Intercommunication among the three valleys, other than at the common source, has been restricted to a minimum. In popular terminology the highlands of the Shan plateau separate the Irrawaddy Valley from the Menam, and those of the Korat separate the Menam and the Mekong.[5] Each valley is, however, peopled on the whole by a racial stock of similar fundamental general origin.[6] The general economic structure within

[3] For the Malay Peninsula see particularly C. A. Vlieland: The Population of the Malay Peninsula, *Geogr. Rev.*, Vol. 24, 1934, pp. 61–78. On Burma see L. Dudley Stamp: Burma: An Undeveloped Monsoon Country, *ibid.*, Vol. 20, 1930, pp. 86–109.

[4] Minor river valleys, such as the Salween and the Meklohng, are considered as parts of the larger valleys, the Irrawaddy and the Menam, respectively. Fundamentally these smaller valleys are dominated by the cultures of the near-by larger valleys.

[5] Also a range of mountains to the east separates the Mekong Valley from the seacoast, giving an additional geographical reason for the dilution of the general Shan blood stock of the peninsula of southeastern Asia by the Chinese, the Annamites, and the Cochin-Chinese. For a general summary of Asiatic migrations in historical times see Radhakamal Mukerjee's "Migrant Asia," *Comitato Italiano per lo Studio dei Problemi della Popolazione*, Ser. 3, Vol. 1, Rome, 1936.

[6] Proofs lie in many fields of investigation. Physiologically most of the data are summarized in my study "The Stature and Weight of the Siamese," *Genus* (Publication of the Italian Committee for Population Studies), 1936. James M. Andrews of the Peabody Museum, Harvard University, has a more elaborate collection of original materials; but these have not yet been published. For historical and other data see Wilhelm Credner: Siam, Das Land der Tai, Stuttgart, 1935; Siam, Nature and Industry, issued by the Ministry of Commerce and Communications, Bangkok, 1930.

FIG. 2—The situation of Siam in the Indo-Chinese Peninsula. Stipple shows the principal areas of rice cultivation in Siam and in contiguous parts of the Mekong and Salween Valleys. (After W. Credner: Siam: Das Land der Tai. Pl. 20.) Scale of map, 1 : 15,000,000.

each valley is approximately similar, determined, in addition to the racial basis, by a common history, a common culture, and an almost identical geographical milieu.

Configuration, temperature, rainfall, and season (as determined by the monsoons) of both the valleys and bordering lands are similar. The chief crop of the central parts of the valleys is wet rice—the staff of life of the southeastern Asiatic peninsula. Methods of economic

utilization have much in common. These include the use of the water buffalo as the main beast of burden in the south, particularly for the cultivation of the underwater rice fields, and the use of the humped bullock (in American animal husbandry called the Brahmin type) as the main beast of burden on the dry lands. In the north, in so far as the elephant is replaced by other beasts of burden, the bullock becomes dominant because water transportation is replaced more and more by the two-wheeled cart. Tools and other methods of exploitation of economic resources are similar in type and distribution—for example, in the south the hand "tamper" for pounding rice and in the north the seesaw, or foot tamper. In the south the rice is generally threshed by driving bullocks over it, in the north by striking the heads of the grain over an upright.

There is also unusual similarity in social characteristics. The three valleys together now comprise the great center of the "southern," "primitive," or "little-basket" pure Buddhism. This version of the Buddhist religion approaches, as closely as any religion ever approaches, the doctrines of its founders, the orthodox and undiluted teachings of the Great Prince of Sakya.[7]

Division of labor among social classes and between the sexes, the standard of living of the people, at least in fundamental elements, and most other characteristics are closely related. Finally, the whole region has a major distinction in that it has a common culture, bordering on the northwest the Tibetan plateau and on the south the Pacific and Indian Oceans and separating the two mighty cultures of Asia, Chinese and Indian, both of which press on its extremities and filter in by migration. It is a thinly populated region with many potentialities, in contrast with the more densely settled areas of different racial and physical characteristics and with relatively fewer economic opportunities for development. (See Table I, p. 386, for the proportions of land under cultivation in Siam.)

Migrations into the Menam Valley

Siam within its present borders has a territory of 200,149 square miles; its length from north to south is about 1020 miles, and its greatest width is about 480 miles. The continental body occupies all the basin of the Menam and most of that of the smaller Meklohng to the west. In the northwest it extends to the Salween, which, although a somewhat larger river than the Meklohng, is dominated by the Irrawaddy culture as the Meklohng is by that of the Menam. The

[7] Northern Buddhism, as far as I can understand its philosophical context, has little psychological connection, or relatively none, with the version called the "little-basket." What I read in the works of northern Buddhism, at least on the continent of Asia (excluding Japan, which is another problem entirely), is nothing more than another name for the main philosophical doctrines of Lao-tse. The "middle path" of primitive Buddhism and the middle course chosen by Confucius seem to have more in common than northern and southern Buddhism.

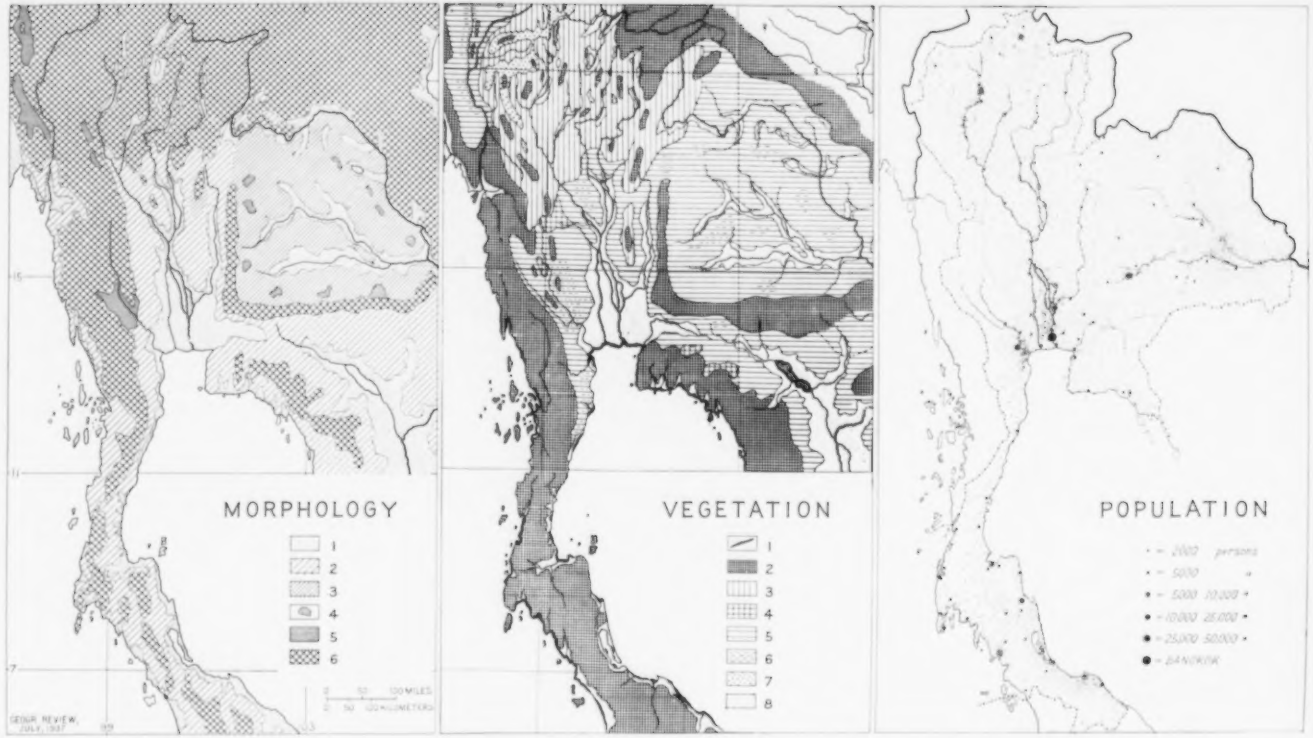


FIG. 3 FIG. 4 FIG. 5

FIG. 3—Morphology of Siam. (Redrawn from Credner, Siam, Pl. 5.) Key: 1, alluvial plains; 2, low peneplains in vicinity of the mountains with isolated mountain-ranges and inselbergs; 3, smooth peneplain landscape of the Korat plateau; 4, table mountains of the Korat plateau; 5, areas of gentle relief in the mountains; 6, mountains. Scale of map, 1 : 15,000,000.

FIG. 4—Vegetation of Siam. (Reproduced from Credner, Siam, Pl. 10.) Key: 1, mangrove; 2, tropical rainforest and evergreen mountain forest of northern Siam; 3, monsoon forest, teak producing region; 4, evergreen sclerophyllous monsoon forest; 5, monsoon dry forest; 6, thornbush and baisbosdry forest; 7, pine and oak mixed forest; 8, rice fields of the alluvial lands, cultural landscape predominant.

FIG. 5—Population of Siam. Based on figures of the Statistical Yearbook of Siam 1929–1930. (Reproduced from Credner, "Siam," Pl. 12; compare endnote 5.)

northeastern territory of Siam includes most of the region between the Menam and Mekong systems, thus incorporating a number of tributaries of the Mekong River, the chief of which is the Nam Mun system. Thus Siam contains not only one of the three great river valleys of the Indo-Chinese peninsula but also elements of the other two valleys and a fair slice of the fourth region or the Malay Peninsula.[8]

In 1929 the population was recorded at about 11,500,000, although the exact numbers, particularly for a city like Bangkok, can be established only with difficulty. Population has been increasing at a rapid rate, and there are probably about 13,000,000 inhabitants in the country at the present time. Almost a million of the people are in the urban aggregate of Bangkok, and the rest in peasant villages or a few small administrative cities or towns. Excluding Bangkok the population density (1929–1930) was about 57 persons to the square mile (22 to the square kilometer). Population is concentrated in the river valleys. The tidewater sections of the Menam and Meklohng contain the largest aggregates, with the short valley of the Nam Mun and its tributaries next. Smaller constellations or aggregates are found on the southeast coast of the Malay Peninsula and in the upper reaches of the west branch of the Menam around Chiengmai.[9]

The populating of Siam is probably the net result of a series of migrations from the north. A negroid population came first. Later came invasions of the Shans: first, the Austronesians (now known as Malays); and second, the people known collectively as Mon-Khmers (called Khmers or Cambodians in the east and Mons in the west). The Austronesians presumably drove the Negritos south off the continent or into the hills, where some survive today as the Semang. It is asserted, even in official circles, that the Mon-Khmers came from India, since "philological and anthropological evidence" seems to indicate that they were related to the present hill people of northern India. For reasons largely inherent in the geography of southern Asia, however, I prefer to explain the Mon-Khmer migration as well as the earlier Negrito and interstitial migrations of the Austronesians or early Malays as a southward migration down the river valleys. One branch of the Mon-Khmers could have migrated into the hills of India. The Austronesians in turn were driven south and east by the Mon-Khmers. Some of them, the Chams of Annam, are to be found in the northeastern part of the peninsula today.

[8] Unquestionably the best general book on the country is Credner's "Siam" (see review elsewhere in this number of the *Geographical Review*). Official statistics of importance are published in English in the "Statistical Year Book of the Kingdom of Siam" by the Ministry of Economic Affairs, Bangkok. Comprehensive data are given on atmospheric pressure, temperature, and rainfall. Credner summarizes these meteorological data and gives many more geographical facts of his own compilation.

[9] Credner estimates 10,180,000 people in agricultural villages, 720,000 in cities and markets, and 500,000 in Bangkok, as of 1920–1930. As a social aggregate there are at least 25,000,000 Tai Shans in southeastern Asia located principally in Siam proper, the French Indo-Chinese protectorate of Luang Prabang, the British Shan States, and the western Yunnan Province of China. By religion, language, and "race" they are essentially one group. See here also Mukerjee, *op. cit.*, Chs. 1, 4, and passim.

The relation of the earlier peoples to the succession of cultures that existed in southeastern Asia and the Malay archipelago is not clearly known. The first great culture whose outlines are comparatively clear from the historical point of view was that established in the Mekong and Menam Valleys by the Mon-Khmers and known as the Cambodian, with its central city at Angkor on a southeastward flowing tributary of the Mekong. Into this civilization came the Tai, a later branch of the Shans, from the Yunnan region and its western borders. They moved southward as agriculturists and workers, primarily by a process of infiltration, as did the early northern barbarians into the Roman Empire. As is usual in such circumstances, the Tai learned the agriculture, philosophy, and civilization of the Cambodians but kept more of their youthful mores of aggression. In time the barbarians took over the empire. Angkor was never a lost city. It was merely a southeastern Asiatic Rome sacked repeatedly by the barbarian Tai, who developed and incorporated much of the blood of their former masters into what is now known as the Siamese civilization.[19]

The history of the migrations is fairly well established. Various historians list large southward migrations of the Tai Shans from the sixth century before Christ. By the twelfth century of our era they were sufficiently numerous in the valley of the Menam to set up a number of petty states fighting for independence from Cambodia, on the one hand, and for leadership among themselves, on the other. King Anarutha the Great of Burma (Pagan) aided their movement for independence when in 1057 he invaded the Menam Valley and temporarily wrested it from the already decadent Cambodian Empire. In 1238 the petty state at Sukhodhai made a successful rebellion. In establishing the first confederate Siamese dynasty in the Menam Valley, this state was aided by the new wave of Tai Shan immigrants from Yunnan who fled south to avoid further difficulties with Kublai Khan. Rhamkhamheng, the second of the Sukhodhai Dynasty (1235–1317 A.D.), created a Siamese state almost identical in extent with that occupied at its greatest development: it comprised the Menam Valley, all of the state of Luang Prabang in the central part of the Mekong, most of the Siamese peninsula, and all of southern Burma in the valley of the Salween.

The capital city of Sukhodhai was just south of the mountains in the upper reaches of the Menam River plain. The successive history of Siam has been one of the developing influence of the river valley in the history of these former upland people. This is to be measured

[19] These hypotheses are supported by the geographical character of southeastern Asia and by what historical and prehistorical facts have been uncovered. Modern communication has not materially altered this situation. The Chinese and Hindus who come into the region are incorporated in time; and, although they affect the blood of the regions where they settle, the old process of clarification begins over again as the peasant with his surplus of population keeps up the deficit in cities, industries, armies, court groups, and upper classes. Credner notes that "Die erste geographische Grundtatsache [of the Tai] ist die Tendenz zur Sudwanderung" (*op. cit.*, p. 178).

by the movements of the capital city down the river and by the concentration of more and more of the population in the lower plains of the Menam. In 1350 the capital city was moved to Ayuthia, and in 1770 to the present site of Bangkok. In this period the center of political control had reached the lower end of the coastal plain of the Menam; and, barring further migrations from the coast of Asia, the southward migration of the Tai Shan was complete.

Economic and Geographical Regionalism

The river valley has thus played a predominant role among the Tai Shans, as it has in the whole settlement and history of southeastern Asia. Further, the geographical regionalism of the country is primarily a question of the organization of the people in relation to the principal and subsidiary river valleys. For this purpose we overlook the other numerous factors and concentrate upon this alone—valley lands and their economic development.

In the studies of Siam made by myself and James Andrews of the Peabody Museum, Harvard University, we recognized four principal regions where Credner recognized six. We agree on the three northern, eastern, and southern divisions. Credner, however, divides central Siam into three—Middle Siam, or the central plain of the Menam; West Siam, the basin of the Meklohng; and Southeast Siam, a coastal region including also the highlands of the divide between the Menam and the tributaries of the Mekong, which join it through Lake Tale-Sap.[11]

Northern Siam

Northern Siam includes the area north of latitude 18° N. between the Salween and the Mekong, the central part of which drains into the four chief tributaries of the Menam. Smaller rivers drain to right and left into the Salween and the Mekong respectively. It is a mountainous region inhabited chiefly by the Laos or upcountry Tai. Population is located chiefly in the river valleys. The cultivated regions are mostly about 1000 feet above sea level. The main food crop is glutinous rice. The chief export is teak. The mountain summits average above 5000 feet, with the highest peak at about 6550 feet. Isolated in the hills are primitive hillsmen generally related to some other branch of the Shans that inhabited the country before the Tai.

[11] For the remainder of this analysis the reader will find the chief data in the following primary sources: Carle C. Zimmerman: Siam: Rural Economic Survey 1930-31, Bangkok, 1931; James M. Andrews: Siam, 2nd Rural Economic Survey 1934-35, Bangkok, 1935; Credner, *op. cit.* See also Carle C. Zimmerman and Phra Chedt Vaidhyakara: A Demographic Study of Eight Oriental Villages Yet Largely Untouched by Western Culture, *Metron*, Vol. 5, 11, No. 3, Rome, 1934; also in *Proc. Internatl. Congr. for Studies of Population*, Rome, Vol. 6, 1934, pp. 335–354.

The division of the central part into three regions is an ancient practice among the Siamese: (1) the area south of latitude 18°, drained by the Menam Chao Bhraya, the Menam Supan, and the Menam Bangpakong; (2) the area drained by the Meklohng; and (3) the area south of the mountains of Chandhaburi. See Siam, Nature and Industry, p. 4.

In this region, according to estimates for 1930, live about [illegible],000, or 15.6 per cent, of the 1,828,000 rural families (the country minus Bangkok) of Siam. In that year they accounted for 40 million bahts, or 13 per cent, of the estimated 308 million bahts (44 cents value U. S. gold of that period) of negotiable economic income of the country.[12] This represented an average of 176 bahts per family for that year. Of

TABLE I—PROPORTION OF UTILIZED LAND SURFACE IN SIAM

REGION	RURAL FAMILIES (COUNTRY MINUS BANGKOK)	APPROXIMATE AREA UTILIZED LAND PER RURAL FAMILY (*hectares*)	TOTAL AREA CULTIVATED OR UTILIZED (*hectares*)*	TOTAL EXISTING LAND SURFACE (*hectares*)	PERCENTAGE LAND SURFACE CULTIVATED
North	286,000	2 1/4	644,000	9,168,000	7.0
Northeast	615,000	1 3/4	1,100,000	16,024,000	6.9
Central	650,000	4 1/4	2,763,000	17,548,300	15.8
South	277,000	1 3/4	493,000	7,258,800	6.8
All	1,828,000	...	5,000,000	50,000,000	10

* Rice, 3,000,000 hectares; tobacco, 10,500; maize, 8500; cotton, 4000; peas, 4000; sesame, 1500; pepper, 2000; homesteads, gardens, fruit, and other small crops, 1,969,300.

this amount, 39 per cent came from crops, chiefly rice; 5 per cent from animal products; and 56 per cent from other sources (jungle products, labor on public utilities or for teak firms, and other services). In addition, the average family head had a house in the village, his garden, his trees (coconut, banana, and other fruits), what fish he could catch, and all the products that he appropriated for himself. Out-of-pocket expenses (food, interest, and taxes) cost him 18 per cent of his income; he saved, invested, or lent out 23 per cent; and 59 per cent was used for direct consumption (food, clothing, housing, and miscellaneous expenses). Of the entire region 7 per cent is in farms, chiefly in the irrigated sections of the valleys (Table I).

NORTHEASTERN SIAM

Northeastern Siam is an upland plateau separating the Menam and the Mekong. The Mekong itself forms the eastern boundary and part of the northern boundary. Elsewhere on the north hills separate it from that stream, and small ranges of mountains serve the same purpose on the south and west. The plateau is inclined toward the southeast (400 to 600 feet in the west to 150 in the southeast) and drains almost entirely through the Nam Mun system into the Mekong.

[12] For the methods of compiling this negotiable income and the items it omits, such as house use in villages and goods only usable by the procurer, see Zimmerman: Siam: Rural Economic Survey, 1930-31, Chs. 3 and 4.

Mean rainfall is about 50 inches a year in the eastern half, about the same as in the north; in the western sections it is drier. The country is settled chiefly by the Lao Tai, similar in culture in nearly all respects to the northern people. About 615,000 families live in the east, mostly in the valley of the Nam Mun. The remainder of the region is practically a dry jungle, owing to concentration of the rainfall within a few months. Practically all agriculture is irrigated, and it occupies only about 6.9 per cent of the surface, despite the fact that with nonirrigated culture most of it would be available for use. In the southwestern part of the region, near Korat, are the ruins of Bhimai, onetime provincial capital of the Cambodian Kingdom. Its architecture is a reproduction on a smaller scale of that at Angkor. At that time the northeast may have supported a larger population than now, but probably it was by a better wet agriculture rather than by an extension of nonirrigated cultures. The Mekong is filled with rapids, so that the principal exit of the surplus rice is down the rivers to the Siamese railways and then out to Bangkok.

In northeastern Siam, according to my studies in 1930, the average negotiable income (an approximation to cash income) was 83 bahts per family, almost three fifths of which came from incidental sources, and the remainder almost equally from rice and animal sources. Extra food took about a third of this income, and the rest was distributed for various incidental purposes. Living is practically self-sufficient; so that, although incomes were lower than elsewhere in Siam, the people were not in such a bad condition relatively. Better cattle, cultivated grasses, and a dry-crop agriculture are the chief needs. Economically such a development would revolutionize the region. Villages that now quarrel over the swamplands would have thousands of acres available for tillage. Most of the people in the region are afflicted with yaws, or frambesia, a condition that could be cured easily by wholesale treatment and a little sanitation.

Southern Siam

Southern Siam consists of the part of the Malay Peninsula that has as its backbone a number of subsidiary ranges of the Tenasserim Mountains. The numerous short streams furnish valleys and coastal plains for the traditional rice cultivation. According to my rough computations the region itself has about 7¼ million hectares of land surface, only 6.8 per cent of which is cultivated by the 277,000 families who reside there. In few places do the ranges exceed 3000 feet in height, but their free exposure to the monsoons gives the peninsula a rainfall sometimes as high as 100 inches a year. Rain falls every month, and the vegetation is that of a green jungle. The people tend more toward the physical type of the Malay than in other sections of Siam. Many of them are Mohammedans.

Tin on the west coast (chiefly Puket Island), some rubber (this and the tin industry were in a slump at the time of my study), some fishing, and a little fruit and animal culture furnish the chief salable commodities. Along with other resources the inhabitants find sufficient soil for wet rice culture to get a living. My studies showed an average income of 125 bahts per family, most of which went for food, incidentals, and debts. This figure is higher than in the northeast, because of the local tin mining and other opportunities for paid labor. Agriculture, however, is lamentably inefficient, as the following quotation suggests.[13]

> In some parts the farmers cut the long grass close, take the foliage away, then cover the land with water to ferment ten days, after which herds of buffalo are driven over it to stir the soil. Weeding the rice consists in cutting the grass close to the top instead of uprooting it. In the short-grass sections land is plowed about three inches deep. No manuring is done. Even where water is available—and that includes a greater part of the cultivable soil in the south than in the other regions of Siam—only one crop is grown. Only a small part of the region is fitted for rice farming, but much of that is uncultivated. Living is easy; hence the people farm carelessly, wanting only a year's supply of padi for their families. The harvesting is done by cutting single stalks of

[13] From observations made jointly with Phya Bhojakara, a Siamese nobleman trained in agriculture, who assisted me in the technical agricultural part of my 1930 study.

FIG. 6—Rice fields in the Menam Valley; jungle in background.

FIG. 7—Shan traders going to the Chiengmai market on the government road. The cargo is fermented tea leaves.

FIG. 8—Ruins of the old capital city of Ayuthia, destroyed by Burmese in 1767.

9—Canal "residences" near the market at Subarnburi in the part of the lower Menam Valley.

10—The fair at Utradit in the upper central Menam Valley.

11—A market scene in a village near Prae, upper Menam

rice at a time with a knife. Crops are carried home over the shoulder. A man will carry home in one or two loads all that he has harvested in a day. Threshing is done by hand. Each day enough is threshed and pounded to furnish the rice for that day's consumption.

Central Siam

Central Siam, as I classified it, includes the lower part of the valley of the Menam, the valley of the Meklohng, and the southeastern seacoast. The entire area is inhabited by the southern Tai, with more Mon blood in the valley of Meklohng to the west and more Khmer blood in the southeast. The region consists of alluvial plains bordered by hills. The central plain is more than 300 kilometers in length and rises slowly from less than two meters above mean sea level at Bangkok to four meters at Ayuthia (head of tidewater), to 25 meters at the head of the delta, and to 44 meters at latitude 18° N. Rainfall in the valley of the Menam is about 50 inches a year, four-fifths of which falls in the rice season. In the southeastern part of the region and in lower southwestern Siam it is much higher. Certain differences in agricultural practice and certain specializations appear in different parts of the region. In southeastern Siam a good deal of pepper and some rubber are produced. In the Menam Valley are

the fruit and market gardens around Bangkok and the tobacco fields of Bhisanulok (Pitsanulok). Rajburi in the southwest, close to the Meklohng, also is a tobacco district. Another economically distinct area is the extensive and poorly cultivated irrigation district of Klong Rangsit.

The prime distinction in central Siam is: (1) lands where paddy rice may be grown, (2) all other lands. The total area comprises about 17½ million hectares of which 2¾ are cultivated or otherwise utilized. Wet rice occupies about 75 per cent of the utilized area (15.4 per cent of all is utilized), and small crops (peas, tobacco, maize, sesame, and pepper) about 10 per cent, with homesteads, gardens, and fruit trees on about 15 per cent. These are very rough calculations.

Central Siam is veined by river and canal systems emptying into the sea at the south. The people live on the levees, sometimes in compact villages though more often the houses are strung along the banks, or where there is insufficient high land, in houseboats. Back of the levees, where the land is lower, wet rice is grown. Around the houses are homestead gardens, mostly of coconut and other palm trees (which furnish the areca nut), but also of fruit trees and bamboo. Each year when the rains loosen

FIG. 12—Houses on canal in the Menam Chao Phaya delta Bangkok.

FIG. 13—A typical water buffalo cart of peninsular Siam.

FIG. 14—A "chedi" or worshipping place in the jungle waterfalls near Chandaburi.

FIG. 15.—Rice boats on one of the canals connecting Subarnburi with Bangkok.

FIG. 16.—Peasant women fishing in a swamp near Chiengmai.

FIG. 17.—Waterwheel of the more efficient type on an upper branch of the Menam at Chiengmai.

the soil the cultivators stir it with a pointed plow pulled by the water buffalo. In the mush thus made they broadcast rice, which grows very rapidly to keep its head above the rising waters as the country is flooded. As the waters recede the fish resources from the swamps are first exploited, then the rice crop. In the dry season the earth becomes hard and cracked. During this season the people live on rice, the drier-season fruits, and fish from the streams. If the fish supply is insufficient and if they have the money from rice sold, they purchase dry salted fish brought in by the Chinese traders.

Back of the rice fields are lands not generally flooded for a sufficient period to produce wet rice. These regions are wild unutilized jungles. In the central valley they form but a small proportion of the land, but at the outskirts and in the remote region between the various small river valleys, they form the predominant part of the land surface. They are unutilized because the concept of a dry agriculture, other than the spade culture of their homestead gardens, is practically unknown to the Siamese.

If dry agriculture were developed, it would mean new crops and abundant resources for many millions more people. However, it

would have to be associated with the use of a plow such as the *krasetra*, which the Ministry of Agriculture has developed, having a share that will turn over the soil. The *krasetra* looks like a miniature breaking plow such as is used in American agriculture. Furthermore, dry agriculture would demand other animals than the water buffalo, such as the bullock, because the water buffalo, which does not perspire through the skin, cannot stand the work. Malaria is a serious factor in the life of the Siamese people; these new farm communities could be made more healthful than the older ones. In one sense agricultural Siam under the old system is in a vicious circle. More money means more rice, and more rice means more irrigation, and more irrigation means more mosquitoes and more malaria. This circle can be broken by expanding a dry agriculture on the higher lands in the center and in the edge of this scoop which is central Siam.

Even the resources of the wet rice lands are not used as they should be. In northern Siam rice is started in seed beds that can be watered if necessary by hand. In the central districts the people wait for the rains to come and do not transplant the rice. If the rains are delayed the rice does not get sufficient start to keep its head above the flood waters. Very few bunds have been built to conserve the water and to extend the cultivable area. In my Siamese study I made the following statement, which I believe is still valid:

> One of the handicaps to the movement [for extending the rice area] is the fact that there is as yet no efficient small farm pump in Siam. The old Chinese wooden trough pump is so inefficient that it requires twice the power actually needed for pumping and delivers water at a tenth of the efficiency of a good cheap metal pump. A good metal pump of pressed steel case, with only one or two castings, should be sold in Siam for about 75 Baht, which is approximately the average price in Bangkok for the wooden pump. The more general use of a two or three horse power farm engine, with a pump capable of lifting a large volume of water as high as two meters should be encouraged. In most sections less than two meters lift will be needed. This is the surest guarantee of a good crop of rice every year in many sections of Siam.

Such practices would greatly increase the acreage under the crop because the edges of the present rice territory, if extended only a few kilometers each way, would add a wide circumference.

In this broad general region, excluding Bangkok, live 650,000 rural families who before the depression had cash incomes yearly of 300 bahts. They constitute about 35 per cent of the rural population of the country, but they produced and consumed about 57 per cent of its negotiable wealth. For a number of reasons, notwithstanding, their relative position is not so high as might be imagined. In the first place, as exporters of rice (an agricultural crop with inelastic demand), they are exposed to the severe and demoralizing fluctuations of the business cycle. In the second place, the influx of wealth with the growing rice exportation has caused abandonment of many old sub-

sistence habits of the past, for instance the buying of clothes instead of making them at home with the unutilized household labor. The fishing areas have been gradually encroached upon by draining them for rice cultivation, so that fish, the chief dietary source of protein animal food, has had to be purchased. Since the fish has to be dried

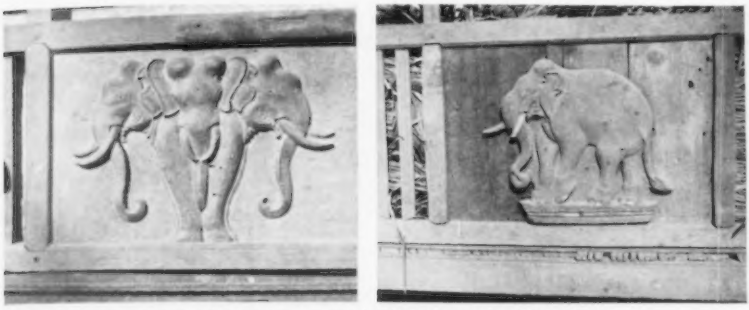


FIG. 18—Decorations on panels of bullock carts at Chiengmai.

and salted for transportation, and since the coming of the rice mills has removed all the pericarp from their rice, the diet is not so well balanced as it was. For the families studied 85 per cent of income was from rice alone. Expenses of producing the rice, interest and payments on debts, and a general high cost of living accounted for most of the amount.

MOUNTAIN SETTLEMENT IN THE CENTRAL BRAZILIAN PLATEAU

Pierre Deffontaines
The University of Rio de Janeiro

TO the arriving traveler Brazil from the seaboard appears a mountainous country; and he carries away with him the haunting souvenir of the Serra do Mar as the background of the Brazilian scene. But this mountainous façade is deceptive; it is simply the scarp of a vast plateau that declines gently towards the interior, the central plateau, whose mean altitude is between 800 and 1000 meters and whose heights rarely surpass 2000 meters. The true mountain form is exceptional in Brazil and is seen only in widely separated islands, scattered fragments apparently of diverse origin. The most elevated point, the Pico da Bandeira in the Serra do Caparão (more than 2900 meters) is an old erosion remnant of gneissic rocks; the Serra dos Orgãos, which reaches 2400 meters in Pedrassú, is a granitic horst; still farther south the massif of Itatiaya is composed of ancient eruptives (syenite and foyaite) to which hard materials it owes its 2797 meters; and a similar explanation can be offered for the phonolite peak of Marins d'Itaquare (2400 meters) and perhaps also the Massif do Sellado (2050 meters), western terminus of the Serra da Mantiqueira.

Are these high mountain islets peopled, and if so what are the forms of mountain economy practiced there? The Andes exhibits a great development of mountain life and the flowering of Indian civilization in South America.[1] Have the Indians of Brazil followed this example? Surprisingly enough, Brazilian archeology reveals an almost complete absence of pre-Columbian remains in the mountain zones. The ancient *aldeias* attained any density only along the Atlantic seaboard and the river banks of the lower parts of the interior. The Indian civilization of Brazil appears to have been preëminently a forest civilization at the collecting, hunting, and fishing stage. Such embryo agriculture as there was, unlike the beginnings in Europe, developed in the forest setting and not on the open grassy campos. The high regions of the serras appear to have been used by the Indian tribes simply as zones of passage in their wanderings. Perhaps this absence of mountain occupation among the early Brazilians is attributable to the complete lack of domesticated animals—the Andes on the contrary enjoyed the llama—and one may ask if mountain economy demands the collaboration of man and his animals? Today in Brazil there still exist unexploited mountain areas, not only in those regions still scarcely open to colonization (as in Serra Muribeca, southern Espirito

[1] Bowman's study in Jean Brunhes: La géographie humaine, 1936 edit., Vol. 2, pp. 623 ff.

Santos but in regions of more ancient settlement: for instance there are truly virgin areas in the state of Rio de Janeiro. Between Therezopolis and Petropolis the high Serra dos Orgãos (Pedrassú, Morro do Castello) knows no human dwelling nor human use, though the soft contours of its senile relief and its grassy stretches invite the pastoralist. Farther to the east the part of the Serra do Mar (Serra de Mocoto, 1800 meters, or Sertão d'Imbé) that overlooks the rich densely populated sugar-producing plain of Campos is still real *sertão*, frequented only by palmite gatherers or charcoal burners. Similarly in the state of São Paulo the mountain forest between Apiahy and Iporanga is almost virgin of exploitation. Yet most of the Brazilian mountains have already been occupied by man and show varied types of utilization—pastoral industry, agriculture, mining, and vacationing.

Pastoral Use of the Highlands

Pastoral use of the mountains could begin only after the introduction of domestic animals brought from Europe, that is to say after the sixteenth century. It is, then, a young pastoral life that is seen in Brazil; and even from the beginning it has been strikingly divorced from agriculture. From the first colonization there have been two types of fazendas, geographically far apart, plantations and cattle fazendas (*gado*). For instance in the colonial epoch a royal decree prohibited the raising of cattle in a littoral zone 50 leagues wide in the state of Bahia, which was reserved for sugar cane. The abundant labor required by the plantations meant a relatively high population density, concentrated in the littoral or on the lower mountain slopes. The plantations replaced forest; agriculture had its point of departure in a forest milieu. The cattle ranches practicing an extensive exploitation and using little labor occupied the grassy campos of the interior plateaus, a diffuse pastoral occupation of immense spaces. The true mountain constituted only a small part of this area and at the beginning remained unutilized. Yet it offered certain advantages. In the dry season or in the dry zones it conserves fresh and nourishing pasture; in the wet season or in the humid zones it affords refuge both from floods and from the parasites that swarm in the low zones, at least during the warm rainy season. These advantages oriented the pastoral economy towards a seasonal utilization of the mountainous areas; even in those highlands where there is no cold nor winter snow pastoral usage keeps its temporary aspect and entails a type or types of transhumance.

Dry-Season Movements

The dates of occupation of the highland zones are not, however, necessarily estival, as in the temperate zones; they are, in fact, more

frequently hibernal, corresponding to the dry season, which in the Brazilian interior accords for the most part with the cold season, April to October. In the Serra São Domingos, which separates the basins of the São Francisco and the Tocantins on the borders of Bahia and Goyaz, the cattle leave the low-lying fazendas in the *município* of Posse, for example, to climb above Riachão and Bôa Vista at the beginning of the dry season, across the plain where the rains come earlier; they remain four or five months in the heights and descend at the beginning of the rainy season.

Farther south, in the Serra do Caparão, almost at 3000 meters, a rather important pastoral economy characterizes the winter months. The high summits of this serra consist of a peculiar campo, not composed of herbaceous vegetation but of dwarf bamboos, *chusques*.[2] This vegetation is transformed into good pasture by frequent burnings that destroy the larger and taller branches; after some years of burning the *chusquesals* comprise only bushes not more than 50 centimeters high at the most and resemble meadows in appearance. The cattle ascend for the winter, which here is not rainless, and remain from February to September. In this latitude the cold is not marked; frost is rare, and the beasts do not suffer. Furthermore, the herds are not bovine cattle, more sensitive to low temperatures, but horses and mules. This specialization of the Caparão derives perhaps from the importance of the bamboo pastures, of which the horses and mules are very fond, but especially because of the scar-

FIG. 1—Southern Brazil showing uplands: the land above 1000 meters altitude is stippled.

[2] *Chusquea baculifera* and *C. pinifolia*. This is the *carafa* of Sellado and Itatiaya; it occurs on other Brazilian summits of the Serra Geral (Itacolomi, Caraca, Ibitipoca), but at Caparão between 2000 and 2900 meters the chusques form a continuous cover, the *chusquesals*.

FIG. 2.—Central Brazil showing uplands (northward and eastward continuation of Fig. 1). Scale approximately 1 : 10,000,000.

city of cattle in the surrounding country. The Caparão forms an island of campos isolated in the midst of the forest zone of Minas Geraes and Espirito Santo, and the raising of cattle in the low forested zones is exceptional. On the other hand, here is a region in which transportation by pack train has played and still plays an important role; to the west is the *matta*, transformed during the nineteenth century into a zone of plantations whose products are carried out on muleback, and farther to the west still is the mining zone of central Minas Geraes, where the mule has been king for two centuries. The Caparão is in fact a small mule preserve. The animals are branded with the owner's mark, and the *tropeiros* look there for the best animals to replenish

FIG. 3—The summit of Pedrassú in the Serra dos Orgãos near Petropolis (2400 meters). The mountain zone here is still unutilized.

their caravans after the winter season.

Elsewhere in the Serra da Mantiqueira, the Selado (2000 meters) and the Campos de Jordão (1800 meters), winter transhumance also prevails. The cattle and horses ascend towards March, remain in the serra till the end of the cold season, and return towards October with the appearance of the rains; during the heavy frosts the beasts seek the valley bottoms wooded with araucarias, here called *grotão*, where they find shelter and feed in the *pinhoes*, the fruits that fall in the winter.

In the northeast of Brazil, the low tableland (sertão) of Ceará is devoted to stock raising. This region suffers notoriously from the terrible droughts, the *seccas*. Formerly the serras that rose above the steppe, especially the great Serra de Baturité, constituted veritable oases where the stock could seek refuge in the driest months, especially August and September; but these serras were early settled by agriculturists, and free pasture has progressively vanished. Today there are only a few corners whither the herds can betake themselves in the dry season; the majority must remain the year round in the sertão. The struggle against drought entails incessant movement, but primitive mountain nomadism is replaced by the nomadism in a horizontal plane of an arid country.

SUMMER TRANSHUMANCE

However, wintering is not the universal form of transhumance in Brazil; in some parts it is a summer practice. The most typical example is the massif of Itatiaya, 200 kilometers from Rio and, with its 2790 meters, one of the highest summits of Brazil. Winter drought is pronounced; springs cease to flow and marshes dry up; vegetation is arrested, the herbage, too hard and dry, is inedible; this is the time of the *quemadas*, the firing of the pastures. The cold, too, is appreciable; frosts occur every year at Passa Quatro, only 1000 meters

FIG. 4—Another view in the unutilized granitic summits of the Serra dos Orgãos.

in altitude; 10° C. below zero was recorded there on June 1, in the famous cold spell of 1918.[3] In the lowlands the insect pests, *bernes* and *carapates*, are especially trying in the summer; then it is that the herds are taken to the heights. The animals leave the fazendas in small contingents in September or October at the beginning of the rains; they take three weeks to travel 100 kilometers or less, and during the first fortnight they succeed in losing their parasites. They remain in the heights until May or June, when lack of water drives them out. The same regime may be observed on the massif of Bocaina, facing Itatiaya on the other side of the Parahyba. This serra culminates at over 2000 meters in Morro Bôa Vista; the summits are open campos, which are used from October to April; the herds pass the winters in the fazendas about Vayão at 1000 meters, ascending in summer to 1800 meters in Mont Redondo and Mont Encantado.

In the state of São Paulo the contrasts between the granitic zone to the east and the peripheral depression that crosses the state from north to south invites pastoral migration. About Casa Branca many of the *fazendeiros* have two establishments, one in the serra between 1000 and 1300 meters, a simple *retiro* where the animals are taken after the grass burning at the beginning of the summer rains; the other, the *sede*, the seat of the fazenda, in the peripheral depression on the border of the rivers Pardo and Verde where the herds are pastured during the dry, cold season.

Similar conditions are seen in the extreme south of Brazil; the high plateaus of Vaccaria (the name is significant) in the northeast of Rio Grande do Sul and the Campos das Lages in Santa Catharina, which culminate at about 1500 meters in the scarp of the Serra do Mar, are used exclusively for pasturage; these are the campos of the *serra da cima*. During the winter the herds descend to the bottom of

[3] Compare Mark Jefferson: Pictures from Southern Brazil, *Geogr. Rev.*, Vol. 16, 1926, pp. 521–547; *idem:* Actual Temperatures of South America, *ibid.*, pp. 443–466.

the *restingas*, the deep-cut valleys bordered by gallery forests of araucarias; it is the dry season, moisture is to be found only in the bottoms; the herds graze under the trees whose fruits they consume. With the heat of summer the unbearable plague of mosquitoes drives them forth to the campos, which at the time of the great rains of September-October (*enchente de São Miguel*, the Michaelmas floods)

FIG. 5—Summit of the high plateau of Paraná. Villa Velha to the west of Curityba. Weathering of sandstone to "mushrooms" similar to the *gours* of the Sahara. Cattle migrate between the open grassy uplands and the wooded (araucaria) valleys. Brazilian Military Aviation Photograph.

exhibit a wonderful growth of tall grass. The movements are strictly local; they take place within the limits of the fazendas themselves, but it must of course be recalled that these vast estates cover some thousands of hectares.

MOVEMENT TO THE LITTORAL

In the same region there formerly flourished another kind of transhumance on a larger scale, which today is almost extinct. This was a movement of the herds to the foot of the Serra do Mar in the littoral zone of Torrés, Conceição do Arroio, whose salty meadows are the *vaccaria do mar*. During the dry season the lagoons dry up, and their beds are covered with a salty herbage, eaten with avidity by the animals whose salt ration is always deficient; here the cattle go to the salt, whereas in general in Brazil salt is imported by the fazendas. This transhumance is the only one operating on the greatest slope of the mountains, crossing the mountain wall almost at the peak, the *apparadas* of the Serra do Mar. Otherwise transhumance in the Brazilian mountains is peculiar in that it takes place on one slope

only, unilateral as it were. This arises of course from the asymmetrical relief of the steep scarp and the gentle incline. But the asymmetry is not confined to topography; it affects vegetation also: the steep southern slope of the Serra do Mar and the apparadas of Rio Grande do Sul subjected to heavy rains (more than 60 inches) carry a dense tropical forest; the gentle northward slope is on the con-

FIG. 6—In the Serra do Mar near Curityba. Contrast between grassy plateau with clumps of araucaria and the steep seaward slopes covered with virgin forest. Brazilian Military Aviation photograph.

trary drier and supports a herbaceous growth, campos broken up by patches of woodland, the gallery forests (*capões*) of the stream bottoms, largely consisting of araucaria. Hence travel southward is difficult, and the movement of herds is directed northward.[4]

HALF-WILD LIFE OF THE STOCK

The movement is one of the few cases of transhumance in Brazil where the herds are led by a *vaqueiro* along selected paths (*piccadas*) in the forest. Pastoral movements in Brazil are typically free, quasi-natural. They involve rather a slow upward grazing than deliberate transhumance; the cattle ascend without conductor to the open country of the heights, where they may remain for months without care as if they were wild. On Itatiaya and the Serra São Domingos the fazendeiros one time or another generally send up *vaqueiros* or *campeiros*. They go up at the new moon to carry salt and to bring down the new-born animals and their dams. On the other hand, the herds

[4] The descent of the herds of the municipalities of São Francisco da Costa da Serra and of São Francisco de Paulo by vertiginous paths across the apparadas is not without danger, and a passage is never made without some loss.

on the Sellado are left completely alone; the beasts themselves make the monthly descent to the fazendas for salt.

The descent of the herds is usually less free. The animals fatten on the mountain, and they can be taken direct to the abattoirs. On Bocaina and Itatiaya the fazendeiros often make two trips: the first in May, to bring down the young animals that would suffer from the

FIG. 7.—The *apparadas*, abrupt seaward descent of the high plateau. View along the railroad from Curityba to Paranagua. Photograph by Paraná Railway Company.

cold; the second in June to round up the hardier animals and despatch them direct to the abattoirs, especially to Rio de Janeiro.

This half-wild life of the stock on the mountains calls for little in the way of human installations—unlike the complex conditions in the Alps, for instance.[5] On Caparão there are two or three ranchos, dry stone cabins to shelter the tropeiros; in Itatiaya there is nothing but the meteorological station. The mountain is empty of men; it is not even parceled out; its acres are *dévoutes*, common land or at least land without title,[6] in any event unenclosed. The cattle are known by the brand they bear, not by the locality. The stock are exposed to the attack of predatory animals, especially the still numerous jaguars. Cattle can defend themselves better than most other domestic creatures, and that explains in part their predominance.

To understand the freedom of movement of the stock, it must be recalled that for long the cattle ranches had no limits save where

[5] Cf. Philippe Arbos: The Geography of Pastoral Life: Illustrated with European Examples. *Geogr. Rev.*, Vol. 13, 1923, pp. 559-575.

[6] However, the fazendeiros of the lowlands seem to have certain ill-defined rights on the uplands. In Bocaina, for example, pastures on the heights cannot be bought or allotted without their authorization. It is doubtless one of those curious cases of an incomplete, diffuse expropriation.

rivers served as bounds, whence the frequency of *fazendas de pontal*. Left to themselves the cattle gather about the older and wiser cows, the *madribhas;* they direct the wanderings and turn the herd towards the well watered and pastured and parasite-free zones. Their movements are so natural that even now in these days of wire fencing the cattle seek to escape through broken places or through openings left

FIG. 8—Virgin forested mountains of the Serra dos Orgãos near Therezopolis with rocks of the "Finger of God." Photograph by José Junqueira Schmidt.

by the fazendeiros. In the Serra São Domingos in Goyaz the few fazendas that have been enclosed must be opened at the time of ascent; otherwise the cattle hurl themselves against the fencing in their frenzy to escape. The fazendeiros cannot combat these movements of their herds. Nor is this exclusively a feature of the mountains. In the dry zones of northeastern Brazil migration is necessary; forage reserves are lacking; during the dry season trust must be placed in the beast's instinct to discover the places where herbage is to be found. In such regions enclosure of the fazendas has hardly begun; it is possible only when combined with the creation of reservoirs (*açudes*) and irrigation.

In some low-lying marshy areas an inverse nomadism exists. The beasts leave the inundated parts at times of high water, as for instance in the *varzea* of the island of Marajó at the mouth of the Amazon and in the pantanal of the Brazilian Chaco. In the latter, the immense swampy region of the Upper Paraguay, during the period of inundations from December to March, the herds of their own accord seek refuge on the larger more elevated islands (*firmes*) and on the borders of the neighboring plateaus.

Even in regions where neither drought nor flood is feared pastoral nomadism is very general. Stock raising proper (*criação*) is carried

on in the zones farthest from the consuming centers, in the sertão of Goyaz and Matto Grosso; but when the beasts reach a certain age, generally two years, they leave the wild campos and are conducted by stages from pasture to pasture toward the seaboard, fattening as they go. These are the *invernadas*. Then they are sold in the great fairs held on the borders of the littoral zone near the slaughterhouses and the centers of consumption.

Mountain transhumance is a particular aspect of pastoral nomadism in Brazil. Is it also an embryonic form of pastoral mountain economy? Has not the first pastoral exploitation of the mountain been dictated by the cattle themselves? Has man invented mountain transhumance or has he not rather been preceded and guided by the instinct of his domestic animals, merely managing and perfecting its technique? Have the extremely complex systems of mountain economy, found for instance in the Alps, passed through the primitive stage of the "natural mountain life" as it still exists in the Brazilian serras? The simple outline of animal husbandry as it is practiced in the mountains of Brazil poses some interesting questions.

It is not at all certain that the Brazilian mountains will remain predominantly pastoral. They may be destined for certain types of agriculture. In Baturité, Ceará, we have seen the herdsman retreating before the farmer. In Borborema, by a curious stratification, the plains in this region remain pastoral; the mountains are agricultural. In many places it is agriculture that has started the utilization of the heretofore deserted mountain.

Course of Agricultural Settlement

The mountain is the stronghold of the small farmer and of polyculture. It supports a type of agriculture very different from that of the great one-crop fazendas that have spread from the littoral zones into the low plateaus of the interior—the matta of eastern Minas, the *terra roxa* of São Paulo, the deltaic plains of the campos.

In general the small-scale mountain farming is much more recent than the plantation, which represents the first phase of colonization; yet it had its beginnings in the eighteenth century to assure supplies for the mining population thronging into the mountains of Minas. Growers of beans, maize, potatoes, onions established themselves near the placers—not at the foot of the slope of the serras, which remained for a century a zone of virgin forest—but on the summit of the escarpment on the high plateau at 1200 to 1300 meters altitude. Between Ouro Preto and Itabirito one might discover a countryside rare enough in Brazil, many little rural agglomerations, veritable villages, clustered round an old clock tower; Amarante, Cachoeira dos Campos, Casa Branca, São Bartholomeu, and Santa Rita.[7] This

[7] Casa Branca and Santa Rita even had small vineyards.

settlement was complementary to the mining settlement and declined with it at the beginning of the nineteenth century. At precisely that time another type of colonization entered on the conquest of the mountain: that of the small independent farmers, true peasants, who wanted parcels of land to cultivate for themselves. All the seaboard lands had been taken up by the plantations, and here the population of slaves or landless laborers was dense enough. On the other hand the grassy plateaus and mountains of the campos, although empty of men, were immobilized by the immense cattle fazendas. Only in the forested mountains was land available. In Rio Grande do Sul the grassy southern part, the Campania, was monopolized by the gauchos, so also were the high campos of the Vaccaria in the northern part of the state. Between the two remained the free serra, forested and mountainous; there in 1824 began the colonization by small farmers; first Germans on the lower slopes around Nova Hamburgo, São Leopoldo, and Estrella, later Italians, higher up, towards 1000 meters about Garibaldi, Nova Trento, Bento Gonçalves, and Alfredo Chaves. On the steep slopes in the deep valleys forest gave way to a varied agriculture, satisfying first the needs of the self-sustaining colony, then progressively engaging in production for export. It was the maize of German settlers that first permitted raising of pigs and production of lard (*banho*), today one of the chief articles of export from Rio Grande. The Italian colonies carefully built up viticulture, which now makes Rio Grande the chief wine producer of Brazil. So the forested serra, empty and unused a century ago, now is the most populous part of southern Brazil. Its population density of 35 to the square kilometer contrasts strikingly with the old stock-raising areas of plain or plateau where the density is scarcely 10 to the square kilometer.

A similar course of events has unfolded in Espirito Santo. The coast alone had been peopled by the old Portuguese colonization; the southwest, completely mountainous and forested, was uninhabited. Colonization by small farmers had its beginnings there in 1840—first Germans about Santa Leopoldina, Santa Izabel, and Tyrol; then Italians about Mathilda and Santa Thereza; finally Poles about Santo Antonio and in the Serra Baunilha. The mountains were cleared valley by valley in a deepening penetration; settlement established itself in the valley bottoms, not concentrated in villages but strung along the river banks with houses 200 to 300 meters apart, the width of the farm lot. Some of the valleys are completely occupied in this manner, the valley of Chanaan, for instance.[8] They not only raised ordinary foodstuffs but also had their small fields of coffee or sugar cane, strikingly in contrast with the great *cafezaes* of São Paulo and

[8] See the description of the conquest of the virgin forest by the great Brazilian novelist Graça Aranha in his book entitled "Chanaan."

FIG. 9—In the Serra dos Orgãos near Petropolis: last fazenda the upper valley: above all is virgin territory.

FIG. 10—In the Serra Muribeca, southern Espirito Santo. tive clearing for small farms on the steep slopes.

FIG. 11—Chanaan Valley in the plateau of Espirito Santo. per valley colonized by Italians. Fruit trees in the fore- ound; the araucarias in the background are the most northerly en by the author in Brazil.

FIG. 12—Crystalline mountains of Espirito Santo near Cachoeira d'Itapemirim. Weathering of the mountain into peaks known as "pontões." Cattle fazenda in foreground.

FIG. 13—Chanaan Valley. Colonization by Italian small farmers. Coffee plantations on slopes with favorable exposure.

FIG. 14—Italian colonization in the Chanaan Valley. Isolated farm near the river which turns the water mill for grinding maize and manioc. Coffee on upper slopes, drying terrace in front of house.

FIG. 15—Granitic massif of Frade on the southern plateau of Espirito Santo. Colonization by small farmers, Italian and German. In foreground an abandoned clearing.

FIG. 16—Ouro Preto, ancient gold mining town and former capital of Minas Geraes, at 1100 meters elevation.

FIG. 17—Workers quarters in new industrial town of Paulo Frontin on the railway from Rio to São Paulo. Hydroelectric force is used in the manufacture of textiles and umbrellas.

FIG. 18—Railroad station of Paulo Frontin. The railroa takes advantage of this, the only place where the mounta barriet is lowered to 500 meters, to penetrate the interior.

FIG. 19—Part of Ouro Preto. The town, now decadent, h many ancient churches and other relics of its former greatnes

FIG. 20—Textile mill of Cascatinha near Petropolis run l hydroelectric power.

the immense *cannaviaes* of Campos. The mountain *capichaba* (Espirito Santo) is one of the few regions of Brazil where there are peasant coffee growers.[9] Today the mountainous part of this state (the *zona fria*, as it is called) is more fully cultivated and will soon be better populated than the old seaboard zone (the *zona cuente*).

Santa Catharina also has a seaboard zone of ancient settlement from the Azores and a more recent settlement in the forested serra, especially German, that began with Blumenau and spread up to the heads of the valleys, including such centers as Brusque, Tijucas, and Nova Trento.

Changing Trends

In Rio de Janeiro, much more anciently and densely populated, the Serra do Mar long remained virgin. A first attempt at settlement —by Swiss at Nova Friburgo in 1818—failed completely. Only after 1850 did German colonization begin around Petropolis and Therezopolis at altitudes between 800 and 900 meters. This highland colonization was directed towards a definite purpose—supplying the rapidly growing town of Rio de Janeiro with milk and vegetables, which could not be had from the marshy lands of its environs. These small farms were first engaged in milk, butter, and cheese production; today vegetables have been substituted for milk; the irrigated bottoms of the high valleys, especially about Therezopolis and towards Nova Friburgo and Venda Nova, have been increasingly invaded by small carefully tilled fields of cauliflower, tomatoes, potatoes, and artichokes.

This function develops rapidly as Brazilian food habits trend toward a European dietary in which vegetables and even temperate-zone fruits take increasing place. In Brazil the market gardens of the outskirts of European towns are situated on the highlands: they are mountain cultivations. Around São Paulo on the high plateaus truck farms multiply; in the last ten years they have transformed the countryside in the municipalities of Cutia and Mogy das Cruces. The recent Japanese colonization has further stimulated this mountain production of vegetables; their minute carefully tended patches of potatoes, greenstuffs, tomatoes, and strawberries contrast with the *rocas* of the old Brazilian agriculture. For instance at Renopolis (2000 meters), to the south of Campos de Jordão, the Japanese have cleared fields for European vegetables, notably tomatoes and cauliflower, and even wheat planted by hand in rows like rice. At present they rank as the highest cultivations in Brazil. This Japanese mountain settlement is in the full flush of prosperity; it has been founded eight years and already counts 8000 families.

[9] Robert S. Platt (Coffee Plantations of Brazil: A Comparison of Occupance Patterns in Established and Frontier Areas, *Geogr. Rev.*, Vol. 25, 1935, pp. 231-239) describes types of small coffee plantations in São Paulo.

A similar trend is seen in other mountain zones. In the Serra da Mantiqueira about Passa Quatro (above 1200 meters) is an arboriculture—apples, pears, quince, and even the vine—so prosperous that the region might not unjustly be called the California of Minas. And this appelation might be applied even more appropriately to another mountain zone in the southern mining region, the still higher region (1300 meters) about Poços de Caldas; vine production there has doubled within a few years. In the Serra da Mantiqueira also, at Campos de Jordão, pear and quince orchards invade the valley bottoms; even plum and cherry trees are being planted; and a small jam and marmalade factory has been established. In 1935 40,000 crates of pears were shipped out of Campos de Jordão. Its largest ranch has 6000 trees.

These productions are spreading farther. Barbacena, the highest station on the line from Rio de Janeiro to Bello Horizonte, at 1300 meters and 300 kilometers from the coast is already assured of an important business in vegetables and fruits; and it even specializes in European flowers—roses and violets—which are finding favor in place of tropical blossoms.

The mountain with its new sort of temperate-zone market gardens thus appears in a complementary role to the low tropical zones. However, this innovation is not without its difficulties. The mountain climate does not exactly duplicate that of the temperate zone. We have already referred to the early Swiss experiment at Nova Friburgo: the colony initially numbered 1600 persons, but not more than a dozen families at most succeeded and remained. The early German colonization in Espirito Santo encountered even greater hardships, and the mortality was such that the mother country finally put a ban on this emigration. On the forested southern scarp of Itatiaya the federal government about 1900 attempted to establish two nucleuses of settlement: the one, Itatiaya, at 800 meters, the other, Maua, at 1300 meters. European immigrants—Germans, Italians, French—were placed thereon; accommodations were built, lots distributed, and vegetable and fruit culture begun. A little annex was named Maceira, because it was devoted to the production of apples (*maceira*). These nucleuses, which originally counted several hundreds of families, are now almost abandoned. The fields won from the forest turned out to be poor and unfertile, and a formidable foe appeared in the ant (*sauva*). Maceira is completely deserted, its ruined houses invaded by the forest, its orchards run wild contending with the bamboos. Maua has held out a little better; its site, to the north of the high crest of Morro Sellado, is somewhat drier; its forest—araucaria with large campos—less compact. Nevertheless there remain only a few families of Germans; Brazilians take back the properties and transform them into cattle ranches. Similar unsuccessful attempts have been made in the Serra Bocaina.

In other cases success of the colonizations has been rapid but ephemeral. In the municipality of Maria da Fé, one of the highest of the southern Minas—the valley has a mean altitude of 1300 meters—the raising of Irish potatoes was begun in 1909 and for fifteen years formed the basis of its prosperity; now an epizootic disease has destroyed the plants, and the countryside is in decadence.

FIG. 21—Low mountains of the Serra do Mar to the south of Rio showing weathering into domes called "meia laranga," half orange. Clearing for pasture; erosion by little parallel rills of the barranca type just beginning.

GROWTH OF HOLIDAY RESORTS

But despite such setbacks the new agricultural development on the forested mountain progresses apace, stimulated by a new class of consumers—the vacationists. The first summer resorts in the highlands of Brazil were those of the Serra dos Orgãos, 50 kilometers to the north of Rio and at 800 to 900 meters altitude. Petropolis and Therezopolis were founded by the Emperor Pedro II in 1870. During the yellow fever epidemic of 1890 they became an official refuge, the government and diplomatic corps were transferred there, and Petropolis assumed capital status. Summer residences have since multiplied—the *chacaras* of the rich *carioques* (inhabitants of Rio) notably about Itaipaya, near Petropolis, and about Quebra Frascas, near Therezopolis. The invasion of residential areas has pushed the truck gardens farther out.

This fashion of summering (*veranismo*) is rapidly growing, and resorts are appearing on all mountain slopes near large population centers. Not far from Petropolis, Miguel, Pereira and Barão do Javary are already filled with summer pensions; farther afield, towns of the Mantiqueira (Barbacena and Ayuruoca for example) acquire

new life in the summer. In the massif of Itatiaya the ruined *nucleo* of that name is being transformed by the erection of a central hotel with villas scattered in the forest. Thermal springs have given rise to the resorts of Poços de Caldas, Lindoya, Cambuquira, and São Lourenço. In Rio Grande do Sul the high serra has been affected. Townspeople of Porto Alegre seek refuge from summer heat at Canella

FIG. 22—Miguel Pereira in the Serra do Mar above Rio de Janeiro, a new summer resort in the mountains. Note the "domed" relief. Forest cleared for pasture; production of butter for Rio; some orange groves. Photograph by José Junqueira Schmidt.

and São Francisco de Paulo. In fact veranismo has conquered the highest regions. Campos de Jordão in the Mantiqueira at nearly 2000 meters altitude has several new centers—Villa Jaguaribe, Capivary, and Ribas for instance—served by electric railway from Pindamonhangaba in the warm Parabyba Valley to the plateau summits. The exceptional dryness of this region has also made of it the most important center of tuberculosis sanatoria, which already count more than 2000 beds.

EARLY MINING SETTLEMENT

This growth of summer resorts creates consuming centers within the mountains, and many heretofore remote corners are being rapidly transformed. By contrast one of the oldest mountain occupations is in slow and steady regression, the mining industry. The first parts of the Brazilian highlands to be occupied were the mineralized areas. The central serra of Minas, the northern branch of the Mantiqueira, is a veritable block of diverse minerals: gold, silver, copper, iron, nickel, etc. The precious metals, of course, were the first attraction, and the first prospectors installed themselves at the foot of the moun-

tain scarps where the rivers descend with their auriferous load; all the watercourses of the piedmont were thus populated with *garimpeiros*—Santa Barbara, Marianna, and Piranga, especially along the Ribeiro do Carmo and the Rio Gualaxo. Progressively the miners ascended the rivers and penetrated into the mountain. Methods of extraction changed; it was no longer the *garimpo* with his placers (*mineração de cascalho*) but extraction from the solid rock (*mineração de morro*).

Mining creates a form of urban civilization: the miners were founders of towns; the mining mountain might be defined as an empty countryside dotted with towns. In the mountain piedmont, the haunt of the garimpo, the instability of placer mining was unable to support many centers; a single town, Marianna, the first of the mining towns, served as capital for the prospectors. On the contrary the miners of the mountain proper were established about the shafts of their mines in numerous centers, some of them of considerable importance. Ouro Preto,[10] founded in 1711, is said to have numbered 100,000 inhabitants at the turn of that century; wonderful relics testify to its magnificence and extent. Other towns equally rich in souvenirs of ancient splendor are scattered over the mining country—Sabara, Queluz, São João d'El Rey, and Caethé.

Similar urban developments are found in the diamond-bearing area to the northeast of Minas and to the west of Bahia. Diamantina, Lenções, Andarahy, Nucugé, and Grão Mogol are centers where the miners came to spend and buy. Cost of living was high, for there was no cultivation in the surrounding country. Even in the minor development of the Serra de Herval in Rio Grande do Sul there were small centers—Lavras and Encruzilhada. Towns of mining origin in fact are innumerable; the mine has given the mountain its fill of towns.

In Brazil, as in many other regions, the mining civilization was a purely urban one. Between the centers was a desolate country; under the demands of the mines the primitive forest was rapidly destroyed; the bare soil, where the ferruginous concretions of the laterite (*canga*) characteristically appeared, supported no pasturage; cultivation for the most part was impossible. A single exception appears in the agricultural villages on the high plateau between Ouro Preto and Itabirito (see above, p. 404).

Decadence of Mining Industry

For more than a century the mining industry has been in decadence; today the greater number of the mining towns are dead; Ouro Preto has not more than 8000 inhabitants. However, the garimpo still exists, and placer mining has indeed taken on a new

[10] Compare P. E. James: Bello Horizonte and Ouro Preto. *Papers Michigan Acad. of Sci., Arts and Letters*, Vol. 18, 1933, pp. 239–258.

impetus with the depreciation of the *milreis* (gram of gold to 20 milreis). Minas counts nearly 2000 garimpeiros, mostly drawn from the poorest of the poor. As to the mines, few only are functioning: the gold mine of Morro Velho has developed an active new town, Nova Lima; iron mines with wood-using foundries are in operation at Sabara, Monlevado, Itabirito, Queluz, and Gagë. But such exploitation as there is is insignificant beside the vast mineral wealth of the mountains of central Minas, notably the resources in iron and manganese. Full utilization awaits the day when the problems of communications and of sources of power and fuel are solved.

Water-Power Resources

Up to the twentieth century Brazil had suffered a heavy handicap in the 3000-kilometer-long barrier of the Serra do Mar. But the mountain, obstacle to development, is destined to play another role in the future—as a source, it may be, of power. Brazil has practically no coal, and up to the present no oil basins have been discovered; but the mountain, especially the seaward border of the Serra do Mar, which almost everywhere receives an annual rainfall of more than two meters, possesses an extraordinary reserve of energy. Already considerable progress has been made. The plant Cubatão, near Santos, supplies power to all the region of São Paulo; Ribeirão das Lages, to the west of Rio, furnishes the capital with part of its power; Alberto Torres, on the Piabanha, sends electricity to Nictheroy; the plant on the Paraguassú to Bahia; that on the Jucu to Victoria; that of Chamine to Curityba. Other great hydro-electric power plants are being installed or considered. Everywhere in the Serra do Mar factories are springing up, using their own power; for instance the textile mills of Cascatinha and of Meia da Serra near Petropolis; the great textile mill of Paracamby; smaller ones at Paulo Frontin and Mendes. In Rio Grande do Sul the chief industries are grouped at the foot of the serra,[11] notably at Cachoeira and in Santa Catharina at Joinville and Blumenau. Thus the mountain takes on a new occupation, industrialism.

So we trace the chief stages of man's conquest of one of the most important elements in the Brazilian landscape; the mountain zone unused for centuries is becoming progressively enriched and diversified. It is no idle conclusion that the mountain will before long rank as one of the essential elements in Brazilian economy.

[11] E. L. da Fonseca Costa: Richesses minérales et houille blanche au Brésil, *Ann. de Géogr.*, Vol. 41, 1932, pp. 618–630.

THE DEMOGRAPHIC, SOCIAL, AND ECONOMIC REGIONS OF GREATER PRAGUE

A CONTRIBUTION TO URBAN GEOGRAPHY

Julie Moscheles
The Charles University, Prague

URBAN geography is mostly concerned with the geographical interpretation of the origin, character, and development of towns. A town is considered as an organism obeying certain laws of an economic or historical order, promoted or stunted in its development by the general currents of traffic, by the market conditions for its goods, by its rise or fall as a merely local or as a regional center making its influence felt over a smaller or larger area. Viewing a town from this angle we are apt to forget that it is a composite organism, that it comprises parts that may and almost invariably do differ widely in economic function as well as in demographic and social character, even when the several parts are truly urban.

In the opinion of the writer the village is characterized by the predominance of either agriculture—the rural village in the accepted sense of the word—or manufacture, in which latter case, for lack of a better expression, the term industrial village will be used. The percentage of people actively employed in commerce, transportation, public service, and the liberal professions will in both cases be small. A rural village may be industrialized without changing its essential village character, without developing the functions of economic and social organization. Or else an industrial village may spring up, as for example in coal fields, without having had an agricultural predecessor. In an urban area the economic (trade and transportation) and social (public service, liberal professions, etc.) services will be more or less developed in each part. No investigations are so far available to tell where the line is to be drawn between town and village. Provisionally it may be assumed that economic and social services absorbing at least 25 per cent of the gainfully employed indicate an indubitably urban character.

When the Statistical Service of Czechoslovakia decided to publish the main results of the census taken on December 1, 1930, not only for Prague as a whole but also for its different "districts" and even for those "parts of districts" exceeding 20,000 in population, the opportunity was welcomed of analyzing the character of the different regions within the agglomeration of Greater Prague.

By the law of February 6, 1920, the agglomeration of Greater Prague had been recognized as one administrative commune including all the settlements that in the course of time had grown up around the old town and formed with it an economic entity. It is true that

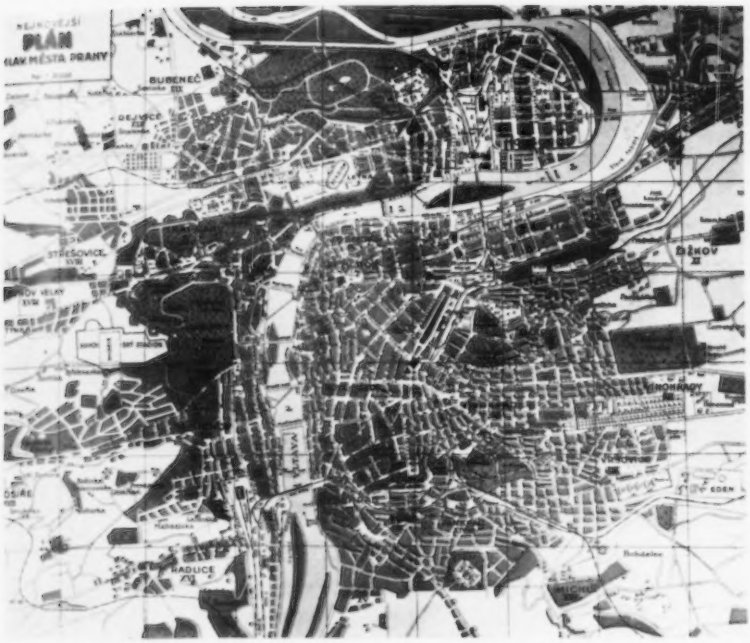


Fig. 1—Map of Prague. Scale reduced to approximately 1 : 75,000. The bulk of the town lies on the right bank of the Vltava River, rising from the valley bottom to the heights of Vinohrady in the east, Vyšegrad and Pankrac in the south. On the opposite bank buildings are restricted to a narrow strip along the river, the steep slope being covered with parks. The westward growth of the town followed small tributaries, thus reaching the high-level plain—Radlice, Smichov-Košíře, and Břevnov are instances of such a growth. Farther north the great meander of the Vltava offered more space for building on the valley bottom (Holešovice-Bubna) and a gentle slope on which the town spread to the high plain of Dejvice. A park, the Stromovka, takes up part of the former inundation area, but beyond it buildings again descend the gentle slope from Dejvice to Dubeneč. The map shows only part of the peripheral belt (see Fig. 6): Michle-Pankrac and Krč (south of Pankrac), parts of Podolí, Radlice, Košíře, and Břevnov-Střešovice. The map does not include the north and east of the peripheral belt (Vokovice, Troja, Vysočany, Malešice, and Strašnice).

the administrative unit is larger than the area actually built over, but on the other hand no part of Greater Prague can be termed either purely rural or purely industrial. Agriculture nowhere occupies more than 5.6 per cent of the gainfully employed, and the share of the productive occupations rises in one case only to 73.6 per cent of the gainfully employed. The statistical data for Greater Prague present the picture of a complete agglomeration, not of a section of the country cut out at random.

Growth of the City

Prague and its development through the ages as expressed in the architecture and general plan of the town have often been described.[1]

[1] On the general regional setting of Prague see Julie Mosch eles: Natural Regions of Czechoslovakia, *Geogr. Rev.*, Vol. 14, 1924, pp. 561–575; for a short account of the historical development of the city see the same: Prague, *Geografiska Annaler*, Vol. 2, 1920, pp. 67–79.

FIG. 2

FIG. 3

FIG. 2—The Old Town Square, the center of Prague I (see Fig. 6), the ancient core of the town on the right bank of the Vltava, with the town hall in the heart of the commercial city of today.

FIG. 3—St. Ludmila Church, Vinohrady, a part of the central section of Prague. With Karlin it comprises the outer circle of the commercial city.

FIG. 4

FIG. 5

FIG. 4—Hradčany (Castle) and Dejvice, socially strong regions of the transitional belt and parts of the administrative town. A green belt, partly occupying a narrow gorge, formerly included in the ancient fortifications of Hradčany separates the two districts. In the background the valley of the Vltava.

FIG. 5—Vršovice, part of the socially weak regions of the transitional belt.

Prague originally occupied the lowland on the right bank of the Vltava (Moldau) inside a large incised bend of the river, a narrow steep ravine on the left bank leading up to the castle terrace, and two isolated buttes formed by this terrace, the Hradčany and Vyšehrad. In the nineteenth century the town spread along the river, up the valleys of its small tributaries, especially on the right bank, over the fairly gentle slopes from one terrace to the next. The rapid growth of postwar Prague has added straggling suburbs, large blocks of apartment houses separated by wide regular streets and interspersed with parks, and also small garden cities scattered on the valley bottoms of tiny brooks or on high terraces. The periphery is connected with the center by long lines of tramways and, to a lesser degree, by busses. Hundreds of steeples and spires speak of the old Prague, but in the busy streets of the city and the adjacent parts of the town, especially where modern buildings have replaced old ones, Prague does not seem to differ much from any business town of America or western Europe.

Prague had nearly 850,000 inhabitants in 1930, it has reached nearly a million now. It is situated where the main lines of traffic by rail and air intersect in their course across Europe. It is the eastern outpost of Atlantic civilization and at the same time the Slav metropolis farthest advanced to the west, through ages the vanguard of Byzantine culture. From the residence of a petty tribal prince it developed into the capital of Bohemia and of the realm of Charles IV, founder of its university (1348). After the battle on the White Mountain in 1620 the Hapsburgs made Vienna the capital of their realm. It had the advantage of being situated on the Danube, but it never had the unrivaled sway previously enjoyed by Prague. Munich and later Berlin developed faster, the first in art, the second in size. Meanwhile Prague was gathering new forces. Removed from the splendor of the court, it became a center of learning and art: in 1769 a group of scientists and friends of the sciences gathered and in 1784 established itself as the Royal Bohemian Society of Sciences. The nineteenth century brought the industrial development of Prague, based on the neighboring rich coal fields of Kladno and on its famous Technical College. The town expanded, but commercial activities continued to be centered in Vienna, though Prague received its first savings bank in 1825 and the first shareholders bank in 1863.

After three centuries Prague in 1918 resumed its role in international politics; it became again the seat of a government, opened its ancient palaces for housing the new legations, constructed monumental homes for its new ministries and highest offices, and solved the housing question for their staffs. In difficult times of postwar effects and economic depression it is trying to build up its commercial structure, creating a central city and the modern equivalent of the

ancient market, the permanent and periodical sample fair, in the transitional belt between city and manufacturing zone, near the river port Bubna. Amidst and around the monuments of the past a new Prague is in the making, combining manufacture and commerce, science and government in its walls, a unit from its very diversity. A study of the social and demographic structure of the population in its several parts may thus be of more than local interest.

Distribution of Children

Perhaps the most striking observational fact in a ramble through the town is the increasing number of children and young people one meets in passing from the center towards the outskirts of the town. That does not mean that one passes simultaneously from better residential quarters to poor districts: in every concentric belt of the town well-to-do and poorer sections exist side by side, but irrespective of this the number of children increases from center to periphery. We check this by examination of the census returns.

In determining the percentage of children in any part of the town one must discriminate between the truly resident population and the part preferably called "accidental inhabitants." There are in fact three groups of accidental inhabitants. One group is formed by the private soldiers enrolled in the army under compulsory military service. The army is not their profession; they live in barracks. They have either no family or their family does not live with them, hence they increase the number of adults in the quarters where the barracks are situated. Another group of nonresident inhabitants is the domestic servants. As a rule they, too, have no family or no family living with them. Their number is largely determined by the social and economic structure of the part of the town under consideration. In parts of the town inhabited by the well-to-do they increase the number of adults and lower the percentage of children. This influence should not be underestimated. For 100 inhabitants (excluding the private soldiers) we find 17.5 domestic servants in Prague V, but only 0.8 in the Michle quarter. The third group of accidental inhabitants is composed of the inmates of charitable and other institutions, but in general their number is relatively small, and there are only two thinly populated parts of the town where their influence makes itself felt.

Greater Prague has nineteen districts divided into 45 parts. Census returns are available for 27 regions (districts, parts of districts, or groups of parts). For these 27 regions the following demographic analysis is presented.

The percentage of children under fourteen within the resident population, i.e. within the total population without private soldiers and domestic servants, varies between 10.3 (Prague V) and 23.6

(Hrdlořezy-Malešice). It is strange that these percentages fall into three distinct categories. The first category with a percentage of children of from 10.3 to 12.9 comprises seven regions situated in the very heart of the town and mainly on the right bank of the Vltava. This group is surrounded by a belt of nine regions in which the percentage of children varies between 14.7 and 17.9. Finally there is an outer ring of ten regions with percentages from 20.2 to 23.6. There remains one region situated in the outer belt with only 16.7 per cent of children—Troja-Střížkov-Kobylisy-Bohnice, with a total population of 13,640 inhabitants including only 18 private soldiers and 153 domestic servants. However, when the several parts are taken separately the percentage of children under fourteen becomes: Troja, 20.4; Střížkov, 22.0; Kobylisy, 19.1; Bohnice, 10.8. The figure for Bohnice, which brings down the average, is accounted for by the fact that it contains the large lunatic asylum of Bohemia.

There is a distinct relation between the number of children and the degree to which the area of a given region is occupied by buildings, streets, and public parks, i.e. the degree to which it is built up. To a lesser degree there is a similar relation between the percentage of children and the density of population of each region (number of inhabitants in one hectare of the total area). In general, the number of children is higher in the parts of the town that are less built up and have a lesser density of population. This has no relation to the density of population due to crowding. The density of population on one hectare of the area covered by buildings varies independently of its site within any one of the three belts distinguished and rests entirely on social and economic conditions (size of flats, area of buildings not used for dwelling purposes). The density of population on one hectare of the area actually covered by buildings is: for the center, 447–952; for the belt of transition, 273–1266; for the peripheral belt, 224–902.

In other words, the number of children increases as one moves from older parts of the town to more recent ones. That does not necessarily mean that a "recent" part of the town is young in years. Prague IV, Hradčany, the castle district, is far older than either Karlín or Vinohrady and is in fact one of the earliest parts of the town. Still it belongs to the transitional belt, whereas the two others, developed only in the nineteenth century, are distinctly parts of the center. A part of the town may be rejuvenated also by a change of its population or by newly erected buildings.

In general the older parts of the town will be most built-up, whereas at the periphery, in the youngest parts, there will be still ample space for future building, and the density of population is largely dependent on the greater or lesser percentage of the area actually covered by buildings. Practically the only exceptions to this correlation between age of a district, built-up character, and number of children were

found to be the two formerly fortified districts Prague IV, Hradčany, and Prague VI, Vyšehrad. In the case of Hradčany the former fortifications are now included in the residential part, and this is rejuvenating the district. Vyšehrad is in similar case, but the influx of new dwellers had not sufficiently advanced in 1930 to make rejuvenation appreciable.

While the age of the population plays a decisive part in the per-

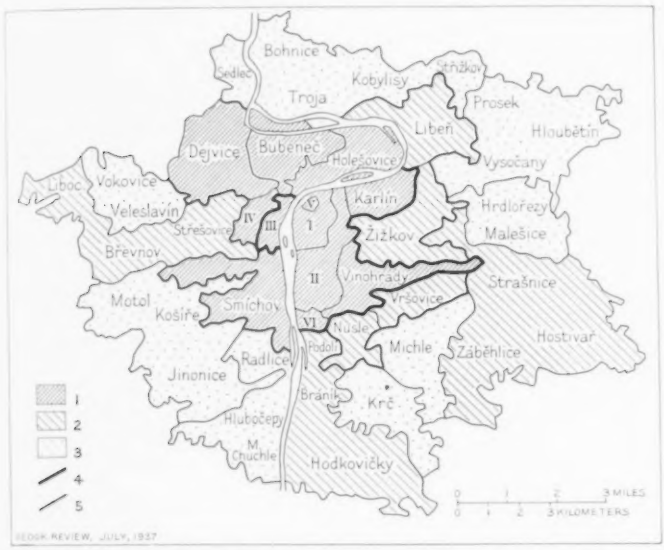


FIG. 6—Regions of Greater Prague classified according to social index: 1, strong; 2, weak; 3, extremely weak; 4, limit of demographic center; 5, limit of peripheral belt. Scale approximately 1 : 210,000.

centage of children characteristic for any given area, it is not easy to determine the age of the resident population according to the definition given. It was decided to consider only the male population over 25 years of age. In so doing the private soldiers are mainly eliminated as they are almost invariably younger. There is eliminated also the influence of the greater or lesser number of children on the "age structure" of the population, as on their number largely depends the number of young people over fourteen years old and still presumably living with and on their parents. There is also eliminated the influence of the greater or smaller number of domestic servants whose age cannot be determined from the census returns available. As among 35,885 domestic servants in Greater Prague there are only 152 males, the age structure of the male resident population would not be affected by them.

The figures obtained in this way show a marked "aging" of the adult male population from the periphery towards the center of the

town. In the peripheral belt men over 45 years of age represent only between 24.5 and 35.4 per cent of the male population over 25 years of age. The only exception is Krč with its home for the aged poor in the Masaryk Social Institute. In the transitional belt the percentage of men over 45 rises from 36.1 to 39.7, and in the center of the town from 41.3 to 54.1. Perhaps another age limit than 45 would give still better results, but figures are available for the different parts of the town only for large age groups (25–44, 45–64, 65–79, and over eighty).

We may then assert that the higher or lower percentage of children within a given resident population is largely a function of the age structure of that population. The housing shortage in the postwar period, when the population of Prague increased rapidly and many tenement houses in the center were transformed into offices, led to legislation protecting the tenants against expulsion or increase of rent. The result was a pronounced stagnation in the center of the town and in the inner (older) parts of the transitional belt where the population grew "overaged." New tenement and one-family houses were built in the outer precincts of the transitional belt and especially in the periphery.

It should be borne in mind, however, that even without protective measures in favor of tenants an overaging of the population in the relatively older parts of the town is likely. People stay on through force of habit, especially when they are no longer young, whereas new homes are likely to be set up in the outlying areas with cheaper rent, with healthier living, often with more conveniences, and, unconsciously perhaps, in revolt against the older generation and under the desire to live among neighbors of the same age, economic standards, and social standing.

So far it has been made apparent that the percentage of children in the different "belts" of Prague is in the main a biological feature, dependent on the age of the resident population and therefore in a way related to the development of different sections and belts of the town. Social and economic relations remain to be examined.

An Index to Social Structure

As an index to the social structure of the town we may conveniently use the number of domestic servants to a hundred homes. In this way the influence of larger and smaller homes is at once eliminated —the influence, that is, of the number of children and of lodgers, as well as of charitable and other institutions on the proportion of domestic servants.

The figures obtained show minimal indices definitely increasing from the center to the periphery, maximal indices increasing from the

FIG. 7

FIG. 8

FIG. 7—Krč, the Masaryk Social Institute, part of the peripheral belt.
FIG. 8—Sporilov. The peripheral belt offers ample room for the development of small garden cities.

periphery towards the center. Differences between the three concentric belts are, however, less pronounced in this respect than in regard to the percentage of children. The variations in distribution of this index may be accounted for partly by habit, by prewar custom among the older population, by a greater need of service because of lesser comfort and labor-saving contrivances in prewar dwellings and because of the very age of the population, which makes it more dependent on household help.

SOCIAL INDEX: NUMBER OF DOMESTIC SERVANTS TO 100 HOMES

	VERY WEAK	WEAK	STRONG	VERY STRONG
Peripheral belt	2.8–5.8	7.6–10.8	.....	.....
Transitional belt	.....	6.4–7.8	15.9–26.7	.....
Center	.....	9.6	19.2–32.7	67.0

The distribution of the social index is shown above. The maximum of 67.0 occurs in Prague V, the former ghetto, a tiny district almost entirely rebuilt before the war and inhabited mostly by rich people because of its convenient site near the river and in the very heart of the town as well as because of its fairly modern buildings. It is not without interest to note that a marked division between well-to-do west end and poorer east end is found only in the transitional belt with its disposition of socially strong regions on the left bank and of socially weak ones on the right bank of the river. In the peripheral belt the comparatively well-to-do regions developed along the continuation of the main streets of the inner parts of the town.

Another index to the social and economic character of the different regions is the percentage of workmen among the gainfully employed population (excluding private soldiers and domestic servants). Now the Czechoslovakian statistics do not give the number of the gainfully employed. Instead they distinguish between persons active in a profession, family dependents not exercising a profession of their own, and domestic servants. The first category is further subdivided into independent operators, officials, employees, and workmen. For the different parts of the city data are not given for each kind of profession separately but only for seven large groups: (1) agriculture, (2) manufacture, (3) commerce, (4) transport, (5) public service and liberal professions, (6) army, and finally (7) a large and miscellaneous group comprising personal and domestic services exercised by people not sharing the home of their clients (barbers, charwomen, etc.), people living on their income and on relief, inmates of all kinds of institutions, and students living away from home. This last, miscellaneous, group is very large for Greater Prague, numbering

altogether 87,700 persons of whom only 1437 are gainfully employed. Strictly speaking these 1437 persons should be taken into account in determining the percentage of workmen, but data on their distribution in the several parts of the town are not available; the number concerned is, however, so small that their omission is negligible.

FIG. 9—Regions of Greater Prague: 1, city; 2, castle town; 3, manufacturing belt; 4, area in transformation. Scale approximately 1 : 210,000.

The percentage of workmen among the gainfully employed in each belt and according to the social character of the regions as determined by the index is thus:

	VERY WEAK	WEAK	STRONG	VERY STRONG
Peripheral belt . . .	58.8–70.5	49.8–55.4	. . . . .	. . . .
Transitional belt . .	. . . . .	45.4–56.8	28.3–41.7	. . . .
Center	. . . . .	48.4	28.6–37.2	13.0

As one would expect, there is a strong negative correlation between the number of domestic servants per 100 households and the percentage of workmen among the gainfully employed, but there is no clear correlation between the percentage of children and that of workmen. Social and economic conditions seem to play in Prague, if at all, a subordinate part in determining the number of children.

TABLE I—PRAGUE: SOME DEMOGRAPHIC, SOCIAL, AND ECONOMIC DISTRIBUTIONS

	Children per Total Population*	Area Covered by Buildings, %	Area Covered by Buildings, Streets, Parks, %	Density Population per Hectare*	Males over 45 per Male Population over 25	Domestic Servants per 100 Homes	Workmen Among Gainfully Employed, %
Center							
Socially strong regions:							
1) Prague I	10.9	43.5	63.5	213	44.9	32.7	37.2
2) Prague V	10.3	52.8	84.9	385	54.1	67.0	13.9
3) Prague II	10.8	44.2	70.8	215	42.8	31.8	33.1
4) Vinohrady	12.1	27.1	61.6	258	41.3	25.6	28.6
5) Karlín	12.9	33.3	57.6	149	42.6	23.1	36.9
6) Prague III (left bank)	12.2	36.1	58.9	170	41.6	19.2	30.3
Socially weak regions:							
7) Prague VI (Vyšehrad)	12.9	14.7	36.7	117	44.0	9.6	48.1
Transitional Belt							
Socially strong regions:							
8) Dejvice	17.6	6.3	14.4	41	33.7	20.4	37.7
9) Bubenče	16.7	10.6	24.3	73	26.7	26.7	28.3
10) Holešovice	15.7	19.6	46.6	103	39.7	15.9	40.2
11) Prague IV	14.8	20.5	37.9	56	39.7	24.3	37.5
12) Smíchov	14.7	14.2	37.5	88	42.8	18.2	41.7
Socially weak regions:							
13) Libeň	17.9	14.0	28.6	60	34.1	7.2	56.8
14) Žižkov	15.6	17.3	37.5	219	36.1	7.5	48.8
15) Nusle	16.0	15.4	30.0	142	36.6	6.4	49.0
16) Vršovice	16.3	15.9	37.1	143	36.6	7.8	45.4
Peripheral Belt							
Socially weak regions:							
17) Břevnov group	20.3	5.0	10.9	28	34.5	10.8	49.8
18) Podolí group	20.9	3.5	8.3	14	32.8	9.4	52.3
19) Strašnice group	21.8	3.0	9.7	13	28.8	7.6	55.4
Socially very weak regions:							
20) Vokovice group	21.6	2.9	7.8	7	35.4	4.8	62.8
21) Košíře group	23.0	2.5	6.9	17	31.3	5.8	59.8
22) Radlice group	21.5	2.8	10.8	10	34.6	3.2	67.9
23) Krč	20.3	3.4	8.0	20	43.3	4.5	64.0
24) Michle	21.6	4.1	13.4	37	24.5	2.8	64.0
25) Malešice group	23.6	2.3	7.5	10	28.2	3.2	70.3
26) Vysočany group	22.3	3.9	12.4	20	29.4	4.6	69.2
27) Troja-Bohnice group	16.7	2.9	6.8	6.5	34.3	4.7	58.8

*Soldiers and domestic servants excluded from the total population.

TABLE II—THE ECONOMIC REGIONS OF GREATER PRAGUE

	PERCENTAGE OF THE GAINFULLY EMPLOYED IN					
	AGRICULTURE	MANUFACTURE	COMMERCE	TRANSPORT	PUBLIC SERVICE, LIBERAL PROFESSIONS	HETEROGENEOUS PROFESSIONS
Prague City						
Prague V	0.2	24.2	47.9	3.1	21.6	3.0
Prague I	0.3	33.9	39.6	3.9	16.0	6.3
Prague II	0.8	31.9	34.0	5.1	22.3	5.9
Vinohrady	0.5	35.2	32.6	8.0	18.8	4.9
Karlín	0.3	41.2	30.0	9.1	14.7	4.7
Prague Castle town						
Prague IV	1.9	32.6	19.8	6.2	33.2	6.3
Bubeneč	0.8	32.7	25.9	8.0	27.9	4.7
Prague III	1.1	35.0	23.3	5.6	27.8	7.2
Dejvice	1.5	38.2	22.0	8.2	25.5	4.6
Břevnov group	1.6	47.4	17.7	8.9	18.9	5.5
Prague Manufacturing belt						
Vysočany group	2.1	67.6	12.3	7.8	4.9	5.3
Malešice group	5.2	62.7	11.9	10.4	4.7	5.1
Radlice group	3.6	61.6	13.3	10.6	6.0	4.9
Libeň group	1.0	59.2	17.3	9.1	8.0	5.4
Michle	1.7	58.5	14.5	12.7	5.8	6.8
Vokovice group	5.3	56.9	14.7	10.0	8.8	4.3
Strašnice group	3.3	54.3	16.3	12.6	9.2	4.3
Košíře group	2.3	54.2	17.3	10.0	10.2	6.0
Krč	3.5	53.9	12.3	9.4	14.4	6.5
Troja-Bohnice group	5.3	53.6	13.5	7.9	15.4	4.4
Prague in transformation						
Nusle	0.5	50.0	20.7	11.1	12.9	5.7
Vršovice	0.5	48.3	20.8	12.3	12.9	5.2
Podoli group	5.0	48.3	18.0	8.9	14.6	5.2
Žižkov	0.4	47.1	24.5	11.3	10.4	6.3
Vyšehrad (Prague VI)	0.6	47.0	21.2	7.6	16.8	6.8
Smíchov	0.7	45.1	24.0	8.7	16.3	5.2
Holešovice	0.6	44.2	24.8	11.8	14.0	4.6

ECONOMIC STRUCTURE

The economic structure of the population corresponds to a certain extent with the social structure, but there are some characteristic differences. The commercial center of the town, the city, comprises the socially strong regions of the demographic center, situated on the right bank of the Vltava. It shows a subdivision into two circles: an

inner one comprising Prague I and V with 39.6 and 47.9 per cent of the gainfully employed engaged in commerce, and an outer circle comprising Prague II with Vinohrady and Karlín where the percentage of those gainfully employed in commerce varies between 30.0 and 34.0. The rest of the center, the left-bank side with Prague III and the socially weak region of Prague VI (Vyšehrad), as well as the whole transitional belt show a generally uniform percentage of those gainfully employed in commerce of from 19.8 to 25.9. In the peripheral belt commerce is better developed in the socially stronger regions (16.3 to 18.0 per cent): for most of the remainder it ranges from 11.9 to 14.7 per cent.

Manufacture represents more than 50 per cent of the gainfully employed in the socially very weak regions of the peripheral belt. It is lowest in the socially strong regions of the center (24.2 to 41.2 per cent) and of the transitional belt (32.6 to 45.1 per cent). There are two distinct minima, the one comprising the very heart of the town on the right bank (Prague I, II, and V), the other on the high level of the left bank (Prague IV and Bubeneč), the low-lying region of the left bank (Prague III) being distinguished by its higher manufacturing index.

The percentage represented by those gainfully employed in transport is closely related to the site of the big railway stations and river ports. It is distinctly lowest in the heart of the town (Prague I and V), and it is lower in the five "old towns" of Prague (Prague I–V) than in the other regions.

Public services and liberal professions are centered around the castle (Prague IV), Prague III, Bubeneč, and Dejvice. This administrative center overflows into the peripheral belt, and a secondary maximum occurs on the right bank of the Vltava River with Prague II and V and Vinohrady (decreasing within this group from 22.3 to 18.8 per cent). Here, however, it is a maximum owing to the commercialized liberal professions—physicians and lawyers—especially in Prague V. The difference in the composition of this group of professions can be evaluated from the percentage of independent operators (i.e., all gainfully employed who are neither salaried nor wage earners) within those active in this group of professions. Their percentage is low where public services prevail (Prague III and IV, for instance) and, on the contrary, is remarkably high in the regions characterized by commercialized liberal professions (Prague II and V, for instance). The fundamental difference in the composition of this group of professions holds good even when it is remembered that those listed as officials and employees in these professions need not be in public service.

Agriculture has been crowded out by urbanization. Naturally it is stronger in the peripheral belt. The only part of the transitional

belt that can compete with this category in its broadest interpretation is Prague IV with its castle, palace, and monastery gardens.

With regard to the professional structure of its population Prague may, therefore, be divided into three distinct economic parts. There is the commercial city on the right bank of the river and entirely in the center of the town; the administrative castle town on the left bank of the Vltava, stretching from the center into the peripheral belt; the outer manufacturing ring including most of the peripheral belt and one part of the transitional belt. In the city more than 30 per cent of the gainfully employed are active in commerce; in the castle town more than 18.9 per cent, in public service and liberal professions (but with less than 10 per cent of their total, independent operators); in the manufacturing belt more than 50 per cent, in manufacture.

There remain seven regions that so far have no well defined economic character. They only recently detached themselves from the manufacturing belt and have still between 44.2 and 50.00 per cent of their gainfully employed active in manufacture. Most of them lie in the transitional belt, but one of them belongs to the center and one to the peripheral belt. It will be interesting to follow their further development. In the north and east it is likely to tend towards commercialization and inclusion in the city. Smíchov may still attach itself to the administrative castle town, and perhaps a university town may develop in the south.

THE CARTOGRAPHICAL RESULTS OF ELLSWORTH'S TRANS-ANTARCTIC FLIGHT OF 1935*

W. L. G. Joerg

Division of Maps and Charts, The National Archives, Washington, D. C.

[With separate map, Pl. III, facing p. 444]

ON the accompanying plate (Pl. III) are shown the maps resulting from the Ellsworth trans-Antarctic flight expedition of 1935. They consist of (A) a map of the eastern coast of Graham Land approximately between latitudes 68°10′ and 69°35′S. on the scale of 1 : 400,000, (B) a map in 1 : 800,000 showing the great linear depression (conjectured to be a fault trough) and its bordering upland features south of Marguerite Bay on the western side of Graham Land, and (C) an inset map, 1 : 800,000, of the Sentinel Range, the isolated range far in the interior, almost midway between the eastern and western edges of West Antarctica. There is also a general map, 1 : 10,000,000 (D), of the territory along the flight track from Dundee Island at the tip of Graham Land to Little America at the Bay of Whales showing the location of the individual maps as well as a few isolated features not included on them.

Construction of the Maps

The maps were constructed from the 66 photographs of topographical interest taken by Lincoln Ellsworth on his two flights of November 21 and November 23, 1935, of which a complete set had been presented to the American Geographical Society by Mr. Ellsworth and of which a comprehensive selection was published in the July, 1936, *Geographical Review*.[1] For the map of the eastern coast of Graham Land most of the 25 exposures of the November 21 flight and of the 16 relevant exposures of the November 23 flight were used; these were supplemented by unretouched prints of 5 of the 7 related published photographs taken by Sir Hubert Wilkins on his flight of December 20, 1928,[2] and a number of hitherto unpublished photographs from the motion picture film made by him on that flight, which had been deposited by him in the archives of the Society and which he has now released for the purpose in hand (of these one, Fig. 9, is published herewith). For the fault depression map 17 photographs of the

*The manuscript has had the benefit of being read in part by Mr. Lincoln Ellsworth and Sir Hubert Wilkins, and in entirety by Mr. Herbert Hollick-Kenyon. In the preparation of the section on the construction of the maps the writer has had the assistance of Mr. O. M. Miller.

[1] W. L. G. Joerg: The Topographical Results of Ellsworth's Trans-Antarctic Flight of 1935. *Geogr. Rev.*, Vol. 26, 1936, pp. 454–462.

[2] Sir Hubert Wilkins: The Wilkins-Hearst Antarctic Expedition, 1928–1929. *Geogr. Rev.*, Vol. 19, 1929, pp. 353–376, photographs L, N, O, P, Q, (Figs. 29–33).

November 23 flight were used. The remaining 8 photographs deal with interior nunataks and the Sentinel Range.

The construction of these maps was carried out under the direction of O. M. Miller, head of the American Geographical Society's Department of Technical Training,[3] according to a technique that has been developed at the Society over a period of years on various projects of a reconnaissance nature.[4] Though the method itself is capable of far greater precision under favorable circumstances, it is nevertheless peculiarly well adapted for coördinating measurements made from uncontrolled photographs. As an aid to the method the special instruments developed at the Society, the photogoniometer and the single-eyepiece oblique plotter, were used for a large part of the work, especially in the determination of heights. By the use of these procedures it has been possible to carry to completion this undertaking despite the formidable handicap presented by the fact that the photographic material, for reasons beyond Mr. Ellsworth's control, was hardly sufficient for photogrammetrical plotting of any kind, with the result that approximations were unavoidable.[5]

Limitations of the Material

In order to evaluate the maps on Plate III properly and to appreciate the varying quality of their constituent parts it is necessary to consider briefly some of the limitations of the material and the steps taken in the endeavor to overcome them.

To produce a map according to the method referred to, where, as in the present instance, ground control is wholly lacking, the following three elements come into consideration for each photograph: (1) height of the airplane at the time of exposure; (2) elevation of the datum level, i.e. of the basic surface, represented in the present case by the sea ice or the ice cap, depending on the area; (3) time, and hence the point on the flight route, at which each exposure was made. Any

[3] The work was begun by John D. Kay, since appointed aeronautical engineer in the United States Coast and Geodetic Survey, who carried out the original identification of common points and their graphic resection to determine their ground positions, and was continued and amplified by W. A. Briesemeister of the American Geographical Society's staff, who carried out the main part of the actual plotting. Mr. Miller supervised the determination of elevations for the map of the eastern coast of southern Graham Land. The contouring and topographic expression of the map of that area are by C. B. Hitchcock of the Society's staff.

[4] O. M. Miller: Experiments at the American Geographical Society in Small Scale Mapping from "High Obliques." *News Notes of the Amer. Soc. of Photogrammetry*, Vol. 1, No. 5, 1935, pp. 25–34 (a development of the approximate method originally presented in *idem:* Planetabling from the Air, *Geogr. Rev.*, Vol. 21, 1931, pp. 201–212, with supplementary note on pp. 660–662; for other references see *Geogr. Rev.*, Vol. 26, 1936, p. 54, footnote 2).

[5] It was this situation that led to the statement in the previous article (Joerg, *op. cit.*, footnote 3) that the photographs did not as a rule lend themselves to this type of utilization. It should be noted that, because of a mechanical defect, it was not possible for Mr. Ellsworth to use the large mapping camera that had been brought on the expedition. Photography was hence limited to his Leica with its exposures 1 by $1\frac{1}{3}$ inches in size. Owing to the construction of the airplane the exposures were made with difficulty and without aid of the direction finder. That the results, when enlarged, turned out so well under such circumstances is a source of congratulation.

two of these elements, if precisely known, would be sufficient to produce the map. The third element, if available at the same time, provides the basis for a check on the accuracy of the other two. Without this check there can be no certainty with respect to the scale of the map. Elements (1) and (3), in the photographic material available, were never sufficiently accurate alone to provide the necessary data, and only in the case of the coast line of southern Graham Land was element (2) available.

The height of the airplane was recorded on the flight from the altimeter readings for the major segments of the flight profile but, for the construction of the maps, was not precisely known for every individual photograph, especially when the airplane was climbing or descending rapidly, in which cases interpolation was necessary.

The elevation of the datum level was satisfactorily determinable only on the photographs relating to the eastern coast of southern Graham Land, it there being the surface of the sea ice as indicating sea level, but even in this area sea ice could not always be readily distinguished from shelf ice and piedmont ice with their different levels. In the interior region the elevation of the surface of the ice cap was available only from estimates made by eye from the airplane, and even these rough approximations were not given for all areas where this datum was needed.

The time of individual exposures was given to the nearest minute in the flight log. In general this is not sufficiently close in orienting individual photographs to one another (in view of the flight speed of nearly two miles a minute), but it does provide a fairly good estimate of absolute position for a group of photographs. The fact that there obviously were several dislocations in the record of the photo-time series introduced a factor of uncertainty in a number of instances. An endeavor was made to eliminate these by an analysis of the photographs according to their natural groups and the reallocation of plausible times to the doubtful photographs. Within the individual groups the photographs were oriented to one another by actual measurement of directional relationships. The scale would be decided by the height of the airplane above the datum level where this datum was available. Otherwise the only determination of scale possible was the time interval between the first and last photographs of a group.

As to the relative horizontal distribution of points appearing within each individual map the results have proved to be quite satisfactory in a number of cases. In certain cases in the map of the fault-depression region the overlap was small, and hence here the horizontal relationships cannot be considered as more than general approximations.

The uncertainty as to the absolute position in terms of latitude and longitude of the areas shown on Maps A, B, and C is due to the

fact that no astronomically determined points were available on the stretches of the route on which these areas were "hung."[6] The areas lie along the larger, eastern, segment of the November 23 flight, whose 1600-mile length is tied down only at its end points, Dundee Island, and the position of the second landing 79°22′S. and 107°30′W.[7] Although fitting the plot of the indicated courses and distances as a unit into this segment called only for relatively minor adjustments, as previously indicated,[8] this did not preclude individual shifts in some of its parts. The discovery, referred to below, that on the two flights another cape was mistakenly identified as Cape Eielson, and other considerations, led to the northeastward shifting of the features in this area as compared with the representation on the sketch map in the previous article (July, 1936, Fig. 1, top). This is likely to be much more nearly correct; but, owing to the lack of actual fixed positions, the latitude and longitude net on the detailed maps on Plate III has been omitted while the areas have been fitted conjecturally into the grid of the general map D.

Geographical Features Shown on the Maps

The geographical features shown on the maps will now be briefly discussed. In this connection an attempt will be made to correlate the findings of the Ellsworth expedition, as laid down on these maps, with Wilkins' discoveries in 1928 on the eastern coast of southern Graham Land and with the work of the British Graham Land Expedition under Rymill, two sledge parties of which have, according to preliminary accounts in newspaper dispatches published while the present maps were being constructed, operated in or close to the two main areas, coastal and interior, shown on Plate III.

Eastern Coast of Southern Graham Land

The map of the eastern coast of southern Graham Land on Plate III, 1 : 400,000, discloses a segment of ice-mantled coast with an outer frontage of about 120 miles conjectured to lie approximately between 68°10′ and 69°35′S. The mountainous coastal belt, possibly a dissected scarp according to Rymill's report, is cut through by a large number of wide valley glaciers of low gradient, which divide it up into numerous capes and headlands, of which some apparently extend out directly to the shelf ice of Weddell Sea and others are fronted by an apron of piedmont ice, whose outer edge is marked by a line of

[6] Two sextant observations each were made on the November 21 and November 23 flights to check whether the airplane was on the precomputed course, but these observations apparently were unreliable.

[7] Position of second landing as calculated by Commander P. V. H. Weems from the field observations. This is almost identical with the previously published value 79°30′S. and 107°55′W. (*Geogr. Rev.*, Vol. 26, 1936, p. 331).

[8] Joerg, The Topographical Results of Ellsworth's Trans-Antarctic Flight of 1935, p. 454.

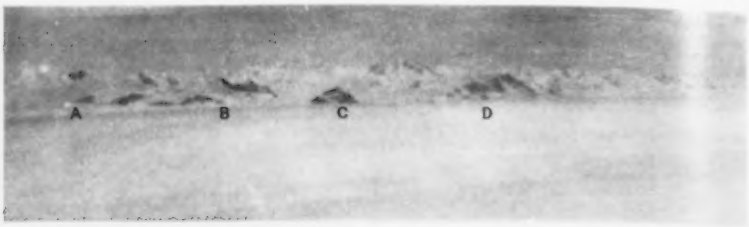


FIG. 1 (continuous across spread of pages)—Bowman Coast, east side of Graham Land, photographed by Wilkins (his photo L).

FIG. 2—Detail of Bowman Coast, photographed by Ellsworth (his No. 5), Nov. 23, 1935 (see Fig. 1, left).

crevasses. This stretch of the coast is divided into two segments, a northern arcuate piece concave towards the sea, and a southern roughly rectilinear piece extending north and south. Both segments meet in a projecting headland.

It is this headland that, to judge by the entries in the flight log when reread in relation to the coast as here plotted, appears to have been mistaken for Cape Eielson. Since it is shown on one photograph only (Fig. 8) it has not been possible to place it definitely in relation to the other features on the map. Its conjectured relative position, as shown, is probably within five miles of being correct. That it should have been mistaken on the flight for Sir Hubert Wilkins' Cape Eielson is understandable inasmuch as only a distant photograph of that cape (photo R of footnote 2, above) was available to the Ellsworth expedition and the headland seen on the Ellsworth flight bears a similar relation to the deep reëntrant in the coast to the northwest of it that Cape Eielson does to Stefansson "Strait" as shown on the sketch map resulting from Wilkins' flight of December 20, 1928 (*Geogr. Rev.*, Vol. 19, 1929, Pl. 4). This deep reëntrant was hence

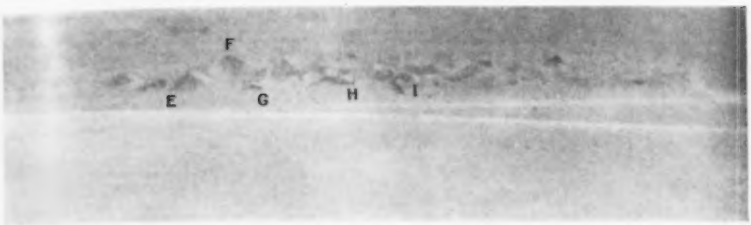


FIG. 1 (cont'd)—Dec. 20, 1928 (first published in *Geogr. Rev.*, Vol. 19, 1929, p. 368, Fig. 29). Identical features on Figures 1, 2, and 3 are lettered alike.

FIG. 3—Northern part of Bowman Coast, photographed by Ellsworth (No. 6), Nov. 23, 1935 (see Fig. 1, right).

logically taken for Stefansson "Strait."[9] Wilkins' Cape Eielson apparently lies considerably farther south, possibly some 70 miles or so down the coast, as conjectured from the relation of Wilkins' photographs P, Q, and R to the photographs on which the present map is based.

At three places along this stretch of coast features on the Ellsworth photographs were identifiable on the Wilkins photographs of 1928.

In the north the dark outliers along the sweep of Bowman Coast, seen by Wilkins from a great distance (his photo L, Fig. 1) as he was flying across the wide bight enclosed by this coast, are repeated on a number of the Ellsworth photographs, especially clearly on photographs 5 and 6 (Figs. 2 and 3).

In the center, features at the mouth of Lurabee Glacier (named Lurabee Channel by Wilkins) and at the mouth of the adjoining glacier to the north correspondingly here named Casey Glacier (Wilkins photographs N and O, Figs. 5 and 6), were readily recognizable on several photographs taken on the November 21, 1935, flight. This is especially true of the northern cliff wall of Lurabee Glacier shown on Wilkins N and the hitherto unpublished photograph from Wilkins' motion picture, of which cliff sections are progressively visible up the Lurabee Glacier on Ellsworth A-15, A-3, A-1 and A-2 (see paired Figs. 8–9 and 4–5). Casey Glacier is viewed looking diagonally up it on Wilkins N and looking diagonally down it to its mouth on Ellsworth 8 (see Figs. 6 and 7).

At the southern end of the stretch of coast a single coincident fea-

[9] The legends of Figures 2–7 in the previous article (*Geogr. Rev.*, Vol. 26, 1936, pp. 456–457) reflect these mistaken identifications. For the probably correct relationship of the photographs see Map A on Plate III.

FIG. 4—Looking northwest along east Graham Land coast (Ellsworth's photo A-3, Nov. 21, 1935). Cliffs A and B are on north wall of Lurabee Glacier, and appear again on Figures 5 and 9. Identical features on Figures 4, 5, 8, and 9 are lettered alike.

FIG. 5—Mouth of Lurabee Glacier photographed by Wilkins, Dec. 20, 1928 (his photo N). See Figures 4 and 9 especially.

ture on the right margin of Wilkins P and the left margin of Ellsworth A-13 has revealed the general relation of the important continuous photographs P and Q (Figs. 10–11) of Wilkins to the map as a whole. The importance of Wilkins P and Q lies in the fact that they represent the northwestern side of Stefansson "Strait," and their linkage with

FIG. 6—Looking up Casey Glacier (Wilkins photo O, taken Dec. 20, 1928). Identical features on Figures 6 and 7 are lettered alike.

FIG. 7—Looking obliquely down Casey Glacier (Ellsworth's photo 8, taken Nov. 23, 1935).

FIG. 8—Looking northwest along east coast of Graham Land (Ellsworth's photo A-2, Nov. 21, 1935). The view extends farther than Figure 4. The last headland on the right is Cape Keeler mistaken by Ellsworth for Cape Eielson.

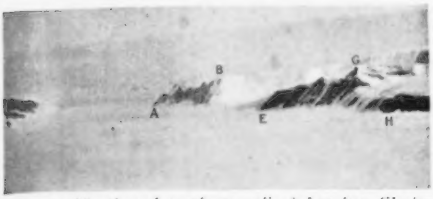


FIG. 9—Mouth and northern wall of Lurabee Glacier (from hitherto unpublished motion picture taken by Wilkins, Dec. 20, 1928). See Figure 5.

the rest of the map hence provides a more reliable clue to the true position of this feature, which the burden of evidence now points to as being a major embayment and not a through channel, than is afforded by Wilkins' original sketch map. Owing to the lack of other coincident points on the two sets of photographs, however, the position on the map, Pl. III, of the features shown on P and Q is indefinite and of far less reliability even than the approximate representation of the rest of the coast.

ETERNITY RANGE AND STEFANSSON INLET

Wilkins' photograph Q, as stated, represents the southern end of the continuous coastal belt derived jointly from photographs taken by Wilkins in 1928 and Ellsworth in 1935. (Ellsworth A-10, A-11, and A-5 show what are probably the higher ridges back of this part of the coast.) The next nearest group of Ellsworth photographs is A-6, A-7, A-8, and A-9, taken on the outward course of the November 21 flight probably about 40 miles or so southwest of the Q area (beyond the limits of Map A; see Map D). The log shows that at this time the airplane was rapidly climbing toward the crest of the range that constitutes the main mountain axis of Graham Land (here named Eternity Range by Ellsworth). The flight was continued toward the southwest about 40 minutes against strong head and mountain winds for an undeterminable distance, at which point the plane turned at an elevation of 10,500 feet because of dense clouds and sped back rapidly northeast on about the same track to the coast. Photographs A-6 to A-9, taken toward the left, hence toward the southeast or east-southeast, show some of the near peaks of the range (A-6 and A-7 are reproduced as Fig. 8 in the July, 1936, article).[10] In the extreme distance

[10] Figure 9, there also ascribed to the Eternity Range, probably shows instead the crest of the ridge lying between Lurabee Glacier and the adjoining glacier to the north.

FIG. 10—Probably the northwestern flank of Stefansson Inlet (Wilkins' photo Q, taken Dec. 20, 1928). Continuous with Figure 11 at A.

another series of peaks is visible. Between the near and the distant peaks there is a wide unbroken snow or ice surface, streaked for its whole length in the middle distance by two dark bands with a narrower lighter band between the two. This is to be seen most clearly on A-9 (Fig. 13), which has an unobstructed view beyond the right (southern) end of the foreground peaks. Although there is no means of determining from the photographs the elevation of the ice surface, the dark bands give the impression of being the middle belt of a long flowing stream of ice, such as a glacier outlet. Inasmuch as the general locational relationships are consistent, there is a distinct possibility that the ice surface with its appearance of a median flow line may be the level ice interpreted by Wilkins as Stefansson "Strait" and that the distant peaks may be on the land whose northern projection he named Cape Eielson.

Subsequent Work of the British Expedition on the Eastern Coast

The results of the British Graham Land Expedition, when published, are likely to clarify this question. According to the preliminary notice so far available[11] a sledge journey by John Rymill, the leader of the expedition, and Lieutenant-Commander Bingham, was made in November and December, 1936, and January, 1937, as a result of which the survey already made by the expedition of the west coast of Graham Land southward from their main base in 68° 10′S. was extended across Graham Land in latitude 69°50′S. (which here is a gradually sloping plateau rising to 7000 feet in the east, where it is bordered by rugged topography with many of the mountain summits over 8000 feet), and its east coast was mapped for 140 miles, as far south as latitude 70°40′. If this distance be taken to refer to the general outline of the coast regardless of its detailed indentations, it may mean that the stretch of coast surveyed extended north to the neighborhood of the 69th parallel. A further statement in the dispatch is to the effect that the surveyed stretch of coast "runs north and south and lies 30 miles east of its previously supposed position," i.e. on Wilkins' map. This would place it roughly along

[11] *London Times*, Jan. 27, 1937 (abridged in weekly edition of Feb. 4, 1937, p. 12).

FIG. 11—(Wilkins' photo P)—Northern continuation of Figure 10. The faint cliff at extreme right edge appears again on the left margin of Ellsworth's photo A-13 (not published).

FIG. 12—This sketch, combining Figures 10 and 11, shows the continuity of the features in this area.

the 63rd meridian, which agrees well with the conjectural position independently arrived at on Map D. Map A (from which D is derived) reveals, as has been seen, a north-south segment of coast whose northern end is represented by the prominent headland of Ellsworth's photo A-2, which was mistaken on the expedition for Cape Eielson. The turning point in the coast, presumably approached by Rymill's sledge party from the south, might well represent the northern limit of that party's survey. If the assumption be correct, and if the conjectured latitude of the cape on the general Map D be accepted, it would confirm that the stretch of coast surveyed by Rymill's party lay roughly between latitudes 69° and 70°40′.

In any case it seems probable that there is an overlap between the photographic survey of the Ellsworth expedition and the ground survey of the British Graham Land Expedition. Such an overlap would be fortunate, as the latter is doubtless fixed by astronomic positions and will probably make it possible to place the Ellsworth survey properly in latitude and longitude. There is hence the welcome prospect that, when the two surveys are combined, polar geography will be the gainer by a map of some 200 miles of hitherto unmapped Antarctic coast. In the overlapped area, whatever duplication there may be will probably serve as a mutual check, and the possibly greater

FIG. 13—View looking southeast past end of range across the depression that is possibly Stefansson Inlet to distant peaks, that may lie on the land whose northern projection is Cape Eielson (Ellsworth's photo A-9, taken Nov. 21, 1935).

FIG. 14—Part of western wall bounding the conjectured fault depression between Graham Land and Alexander I Land. (Ellsworth's photo 21, taken Nov. 23, 1935). Note stratified rocks in left foreground.

FIG. 15—Looking southeast across the conjectured fault depression (Ellsworth's photo 26, taken Nov. 23, 1935). Stratified rocks of western bordering upland in left foreground, conjectured eruptive rocks of eastern upland in left background.

precision in detail of the ground survey will be compensated by the wider areas made visible in the air survey.

THE GREAT FAULT DEPRESSION AND ITS BORDERING UPLANDS

The second main map (B) of Plate III, on the scale of 1 : 800,000, represents the great linear depression and its bordering mountainous uplands that were discovered by the Ellsworth expedition shortly after the airplane had entered on its long cross-continental flight on November 23, 1935. Although their position in latitude and longitude is even more indefinite than that of the eastern coastal strip, the connected area represented on this map may be conjectured to lie roughly between 69⅓°–72°S. and 66°–71°W. (Map D). The gap thus left between the coast and the first of the ranges bordering the depression on the east is by no means featureless; indeed, it is filled with mountains up to 11,000 feet high, trending southeast, that represent the main Graham Land axis[12] but that it was not possible to photograph because of clouds. Photographs A-6, A-7, A-8, and A-9, already mentioned as taken on the outward course on November 21, which here parallels the November 23 course probably at a distance of some 50 miles, hence apparently remain the only photographs available of the main axis, the Eternity Range (A-6 and A-7 published as Fig. 8 in the July, 1936, article; A-9 as Fig. 13 in the present article).

For an interpretation of the features shown on Map B the results of another sledge trip of the British Graham Land Expedition, of which

[12] Communication from Mr. Hollick-Kenyon dated July 15, 1936.

a preliminary account has also been published in the press,[13] may afford a clue.

In September, October, and November, 1936, Alfred Stephenson, G. C. L. Bertram, and W. L. S. Fleming explored a remarkable sea-ice-filled strait about 15 miles wide, flanked on both sides by high land, that extends for about 200 miles in a S15°E direction from the southern coast of Marguerite Bay, which coast on an immediately preceding reconnaissance flight on September 4 had been found to lie in about 69°30′S. The party sledged along the strait until, in

FIG. 16—Southern continuation of western bordering upland of fault depression. (Ellsworth's photo 27, taken Nov. 23, 1935). The cloud-obscured cliff in left foreground appears clearly at the right edge of Figure 15 as a dark flat-topped massif.

72°S. and 67°W., it appeared to open out into a bay facing westward. The journey southward followed the eastern side of the strait, whereas the return was made along its western side. Opportunity was thus afforded to view both flanking walls close by. The eastern side constituted the west coast of Graham Land. No sea-level channels entered it. On the basis of this evidence and of knowledge gained from other surveys made on the expedition, it was determined that this western coast continues unbroken for at least 450 miles from Matha Bay (in 66°45′S.) and that Graham Land is hence not an archipelago. The western side of the strait was found to be the eastern coast of Alexander I Land, which therefore is very much larger than assumed from the work of Bellingshausen in 1821 and of Charcot in 1909. The Graham Land coast of the channel was characterized by eruptive rocks akin to those of the same coast farther north. On the great bluff of the Alexander I Land side stratified sedimentary rocks were exposed that yielded fossil invertebrates and plants that will probably serve to interpret the structure and age of the adjacent Graham Land mountain arc. "The strait is bounded on either side," the dispatch concludes, "by such strangely different ranges that it must be one of the most impressive fault features of the earth's surface."

Between this description and Map B with its underlying photographs there are distinct similarities, which afford a clue to correlation between the two.

[13] *London Times*, Dec. 12, 1936 (abridged in weekly edition of Dec. 17, 1936, and digested in *Polar Record*, No. 13, Jan., 1937, pp. 85–86).

On the long north-south range shown on photographs 17, 18, 19, 20, and 21, with its foreground continuation on 23 and 24 (in the previous article the right half of Fig. 10 is photograph 19 and the left half is 20, and Fig. 11 is 23 and 24), exposures of stratified rock seem clearly evident in a number of places, especially on photographs 20 and 21 (Fig. 14). A similar exposure clearly appears on the foreground range of photograph 26 (Fig. 12 in the previous article, here repeated as Fig. 15), the northern continuation of which range apparently is seen in the foreground of 25. When the two sections of the map on opposite sides of the flight route that are based respectively on photographs 17–18–19–20–21–23–24 and 25–26–27–28 were, during construction, "hung" on that route according to the interpretation of the time record, the ranges with stratified exposures on both sides of the route fell into alignment. This would seem to make probable that they are continuous. Their further continuation to the south would seem to be represented by the ranges partly characterized by flat-topped spurs that appear in the middle ground of 26 (Fig. 15, on the extreme right), 27 (Fig. 16), and 28 (on the right; not published).

Beyond (east of) this stratified range and between it and the serried ranks of massifs in the background of 25, 26, and 28 (of which 22, an individual non-overlapping photograph, may represent the northern continuation), with their suggestion of different rock structure, lies a long uninterrupted ice belt, which, according to the plotting, has an average width corresponding closely to 15 miles.

The conditions therefore seem to approximate those of the description; and, if they be accepted as identical, then the long uninterrupted ice belt would be the great fault depression explored on the sledge journey of the British Graham Land expedition, and the stratified range and the massifs of different rock type would represent its enclosing uplands of sedimentary and eruptive rocks respectively. This identification would seem to be strengthened by the wireless message sent by Hollick-Kenyon to the expedition's vessel base at 14.35 on November 23, 1935, just as the airplane was approaching the depression: "The big range to the right [i.e. the western wall, shown on photographs 20 and 21, taken at 14.37 and 14.43] goes to the south for a long way . . . On the east side of the range this wide level-bottomed valley seems to run from the hinterland south right north towards the sea . . . The mountains here are sedimentary. . . ."

As to the absolute position of the fault depression in terms of latitude and longitude, neither the map based on Ellsworth's photographs nor the preliminary newspaper account of the British expedition can be conclusive. Its S15°E trend and 200-mile length to the end of the sledge trip in 72°S. and 67°W., mentioned in the dispatches, fit well the representation on Map B. From the dispatches it is not fully clear whether the strait starts at the southwestern or the south-

eastern corner of Marguerite Bay. Its western wall as plotted from photographs 17, 18, and 19 would tend to indicate that it starts at the southwestern corner. From the southeastern corner, in any event, starts what is probably a secondary feature, a broad gently sloping glacier that leads upward and apparently in a southerly direction to a low pass beyond which another glacier occupying a depression 5 to 10 miles wide flows apparently southwest and empties into the strait in about 20 to 25 miles.

If the identification here advanced of the fault depression on the 1:800,000 map be accepted, then all the ranges on photographs 20, 21, 23, 24, and 27 and the foreground range of photographs 25 and 26 would lie on the enlarged Alexander I Land as interpreted by the British expedition. Of the remaining photographs going to make up Map B the range shown on 30, which may be a southern continuation of those shown on the right border of 27, the ice-buried range in the middle distance of 31 (Fig. 14, left, of the 1936 article) and the sharp near-by peaks of 31, 32, and 33 (same Fig. 14, right), as well as the long range projecting from the cloud blanket in 29 (Fig. 13 of the 1936 article), which appears to parallel the range forming the western wall of the fault depression—all would lie within Alexander I Land.

Isolated Nunataks and the Sentinel Range

Beyond the area shown on Map B, the southernmost of whose ranges appears on photograph 31, the remaining eight photographs (34–41) portray only isolated, widely separated features. The general picture is that of a vast ice plateau interrupted by occasional nunataks. Not all that were observed could be photographed.

Between 16.15 and 16.45 o'clock, when the airplane was flying about from 73°S. and 72°W. to 73¾°S. and 74°W., reference is made in the log to sighting a number of such exposures to the right of the course. Similar ones appear in photographs 34, 35, and 37 to the right and 36 and 38 to the left (34 was published as Fig. 15 in the 1936 article, 36 as Fig. 16), which plot approximately within the quadrangle enclosed by 74⅓°–75°S. and 76°–78°W. At 17.20, from a conjectured position in 74½°S. and 76°W., mountains were sighted abeam to the left, estimated to be 120–140 miles away.

The last three photographs, 39–41 (39 is Fig. 17 of the 1936 article, 41 is Fig. 18), represent the Sentinel Range (so named by Ellsworth). In contrast to the preceding nunataks, which, according to the time record, lie about 275 miles back (northeast) with the featureless ice plateau intervening along the line of flight, the range is a mountain feature of major proportions. The present plotting of the photographs (Map C) indicates that it consists of a main range and a number of subranges and outliers, the whole group trending

northeast-southwest from its northeastern end in about 77½°S. and 86°W. for more than the 35 miles shown up to the right border of photograph 41, which cuts abruptly through the main range.

Beyond (southwest of) the Sentinel Range the existence of other mountains seems indicated by the statement in Ellsworth's log at the time photograph 41 was taken abreast of the Sentinel Range (19.44 estimated in 77¼°S. and 88°W.): "ahead and on southern horizon a long black mountain chain visible." The existence of these mountains is confirmed by Mr. Hollick-Kenyon.[14] He states that at this time further peaks came into sight on the southern horizon, which he estimated to be 125 miles distant. They were so distant that it was impossible to distinguish any details of their appearance. The general locality indicated would fall within the quadrangle 78°–80°S. and 85°–90°W. on Map D.

These were the last mountains observed on the flight. Beyond, for what amounts to half the distance across West Antarctica, only the uninterrupted ice-cap surface was met with, descending gradually in this distance of more than 800 miles from an elevation of over 6000 feet to 1000 feet near its crevassed border where it merges into the Ross Shelf Ice 150 miles east-southeast of Little America.[15] No air photographs were taken in this 800-mile stretch.

Conclusion

From the foregoing discussion of the main features of the accompanying maps and the photographs on which their representation is based it appears that the Ellsworth trans-Antarctic flight expedition has produced the first maps of two important areas, one of which was previously known only in sketchy outline and the other wholly unknown until the flight of November 23, 1935. The first area (eastern coastal belt of south Graham Land) is about 2300 square miles in extent, the second (fault-depression area) about 9000 square miles. The results demonstrate again the value of air photography in reconnaissance exploration, even under the limitations considered at the beginning of the article.

[14] Communication dated March 25, 1937.
[15] *Geogr. Rev.*, Vol. 26, 1936, pp. 329–332.

MAPS OF THE ELLSWORTH

(B)

CONJECTURED FAULT DEPRESSION

SOUTH OF MARGUERITE BAY

Western Coast of Graham Land

between 69°20′ and 72°10′ S. approximately

Approximate scale 1:800,000

Statute miles 0 10 20 — Kilometers 0 10 20 30

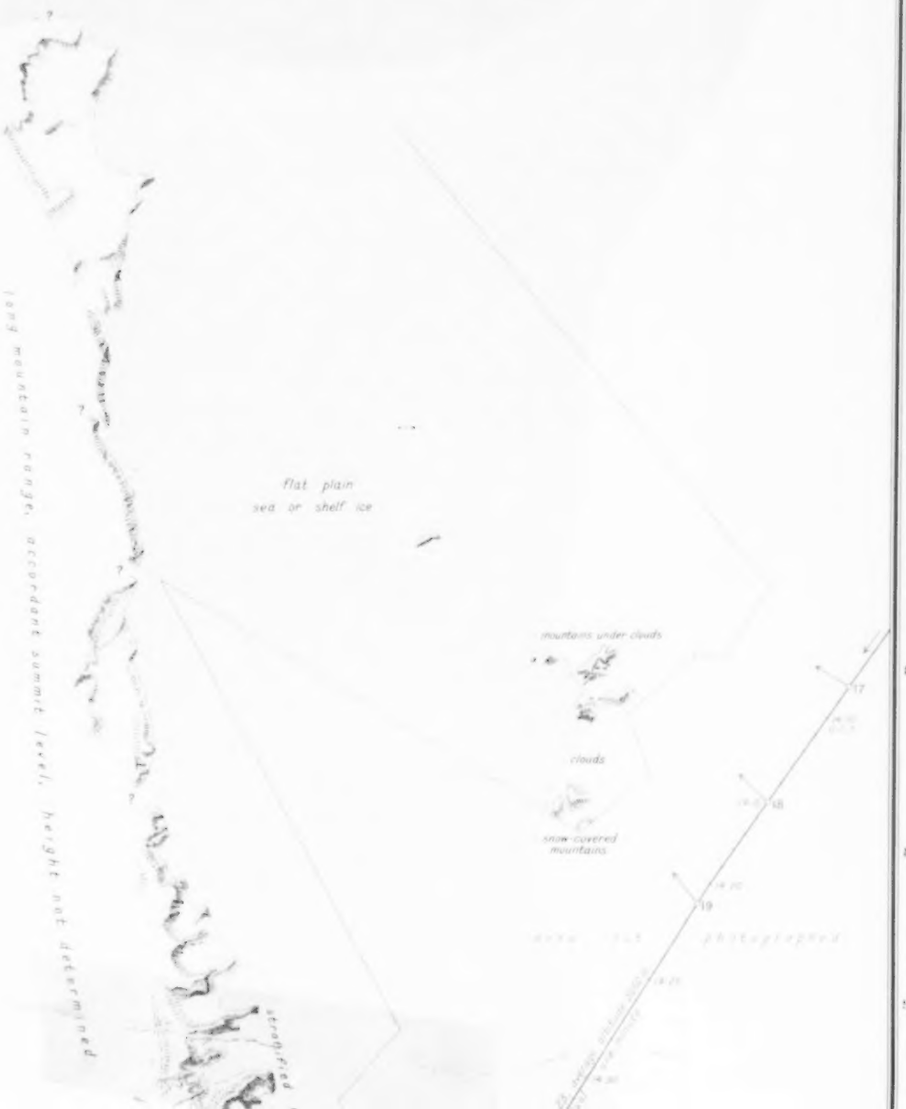
FLIGHT TRACK

Ellsworth Nov. 23, 1935 photographs 17 to 33

Rock exposures — Base of mountains

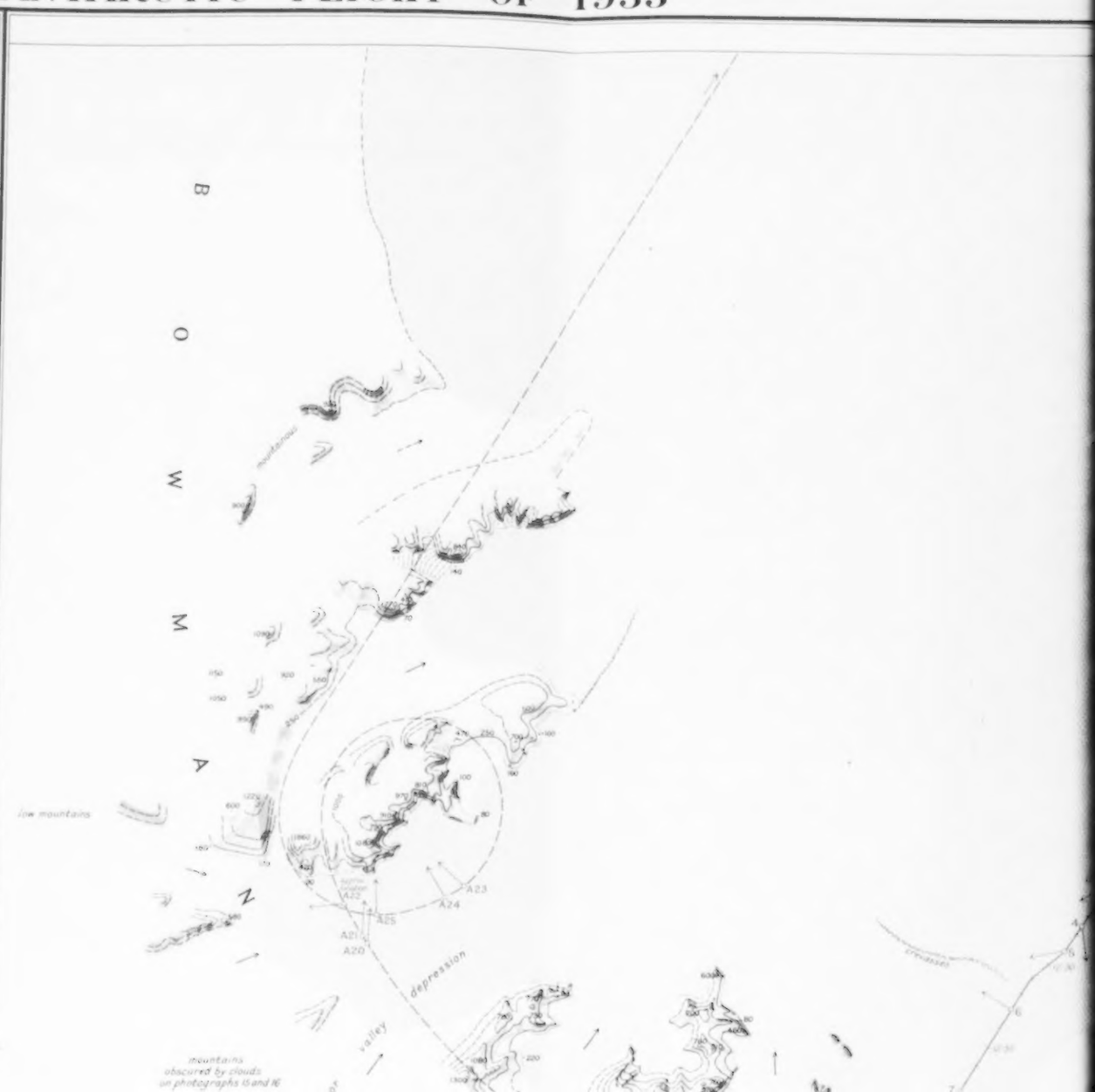
PUBLISHED PHOTOGRAPHS

Ellsworth's Photographs	Geogr. Review July, 1936 Fig. No.	Geogr. Review July, 1937 Fig. No.
19	10 right	
21		14
23	11 right	
24	11 left	
26	12	15
27		16
29	13	
31	14 left	
33	14 right	
25	Geogr. Journ. March, 1937, opp. p. 199	



Copyright, 1937, by the American Geographical Society of New York

PS OF THE ELLSWORTH TRANS-ANTARCTIC FLIGHT OF 1935



Map C

Mt Mary Louise Ulmer
elev. about 3900 m.

Sentinel Range

last mountains seen
(roughly estimated position)

water
sky

JAMES W. ELLSWORTH LAND
(Claimed for the United States by Ellsworth)

First camp
landed 21:55 Nov. 23
took off 17:00 Nov. 24

HOLLICK-KENYON PLATEAU

Second camp
landed 17:30 Nov. 24
took off 00:00 Nov. 27

Third camp
landed 00:50 Nov. 27
took off 19:20 Dec. 4

BYRD LAND
(Claimed for the United States by Byrd)

MARIE BYRD LAND
(Claimed for the United States by Byrd)

ROCKEFELLER PLATEAU

Mt Mabelle Sidley
3000

Mt Hal Flood

Edsel Ford Range

Paul Block Bay

Sulzberger Bay

Bay of Whales

SCOTT LAND

Fourth camp
landed 23:10 Dec. 4
took off 09:00 Dec. 5

KING EDWARD VII LAND

ROSS SHELF ICE

ROSS DEPENDENCY

Roosevelt I.

Fifth camp
landed 10:05 Dec. 5

Cape Colbeck

Little America V
Bay of Whales

ROSS SEA

FLIGHTS OF THE
ELLSWORTH TRANS-ANTARCTIC EXPEDITION

Scale 1:10,000,000

Statute miles 0 50 100 150 200 250
Kilometers 0 100 200 300 400

FLIGHT TRACKS

Ellsworth Nov. 23, 1935
Ellsworth Nov. 21, 1935
Wilkins Dec. 20, 1928

1000 Heights in meters

74° 76° 78°

relative position approximate

nunataks

mountains obscured by clouds on photographs 15 and 16

major valley

COAST

Photographs 39 and 40 published in Geogr. Review, July, 1936 as Figs. 17 and 18

C

SENTINEL RANGE
Scale and key same as map B

high mountains continue beyond edge of photograph

Mt Mary Louise Ulmer
highest peak est. mated 3900 m.

approximate position of high crests shown on photographs 13 and 14

Casey

snow and ice-cov
scattered roc
(summits estimated
at 1500 m appro

Scri

Construction of maps A, B, C from airphotographs by John D. Kay and W. A. Briesemeister and topography of map A by C. B. Hitchcock according to methods developed by O. M. Miller at the American Geographical Society. Composition and editing of map by H. L. G. Joerg. Drafting by W. A. Briesemeister and Stanley F. Smith

The Geographical Review, Vol. XXVII, No. 3, 1937, P. III

A

EASTERN COAST OF GRAHAM LAND

between 68° 10′ and 69° 35′ S. approximately

Approximate scale 1:400,000

Statute miles 0 5 10 — Kilometers 0 5 10 15

FLIGHT TRACKS

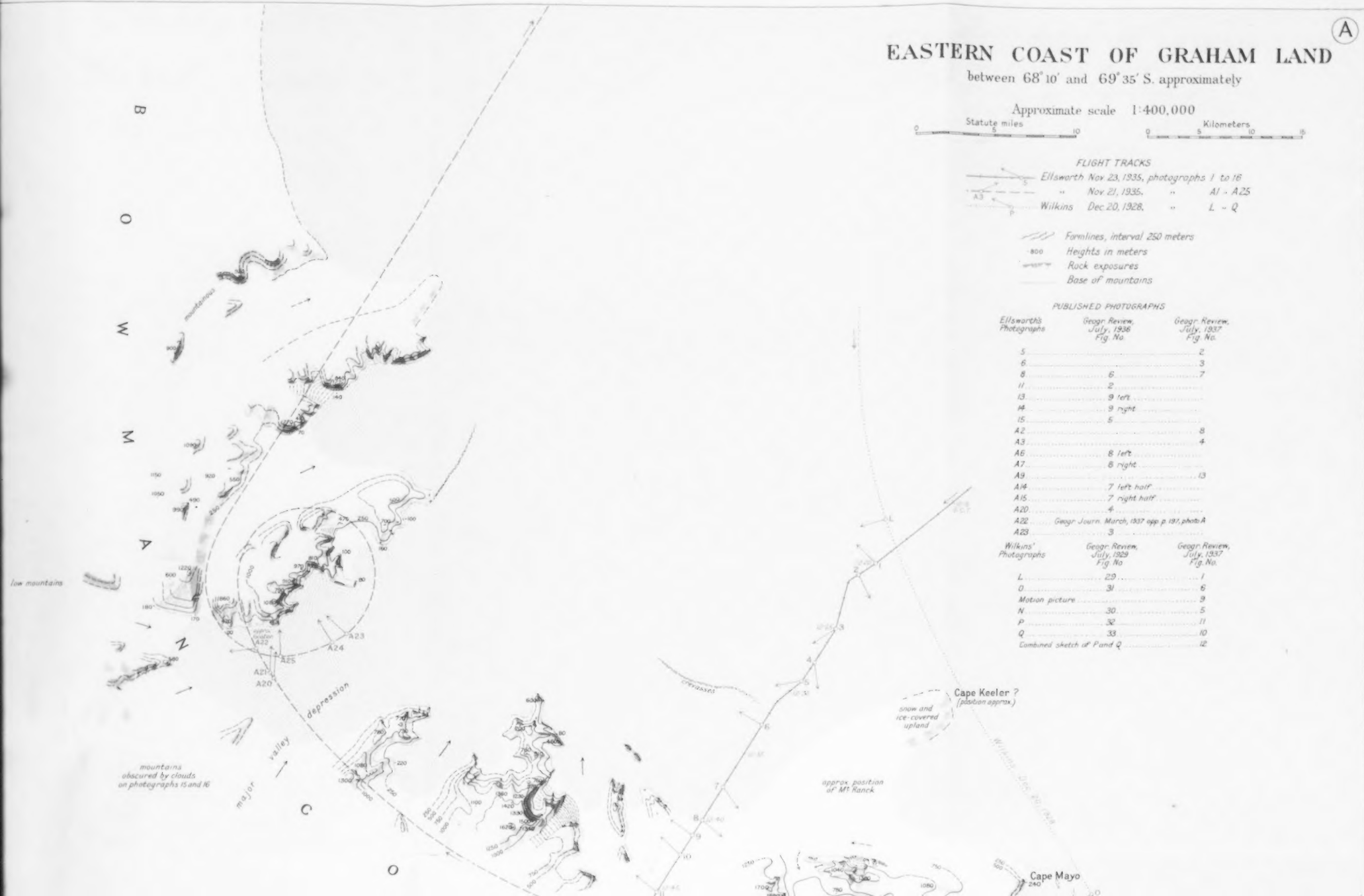
Ellsworth Nov. 23, 1935, photographs 1 to 16
" Nov. 21, 1935, " A1 - A25
Wilkins Dec. 20, 1928, " L - Q

Formlines, interval 250 meters
800 Heights in meters
Rock exposures
Base of mountains

PUBLISHED PHOTOGRAPHS

Ellsworth's Photographs	Geogr. Review, July, 1936 Fig. No.	Geogr. Review, July, 1937 Fig. No.
5		2
6		3
8	6	7
11	2	
13	9 left	
14	9 right	
15	5	
A2		8
A3		4
A6	8 left	
A7	8 right	
A9		13
A14	7 left half	
A15	7 right half	
A20	4	
A22	Geogr. Journ. March, 1937 opp. p. 197, photo A	
A23	3	

Wilkins' Photographs	Geogr. Review, July, 1929 Fig. No	Geogr. Review, July, 1937 Fig. No.
L	29	1
O	31	6
Motion picture		9
N	30	5
P	32	11
Q	33	10
Combined sketch of P and Q		12



UNIV. OF MICH.

A. Hoen & Co. Lith. Baltimore, Md.

Construction of maps A B C from aerophotographs by John D Kay and W A Briesemeister and topographic map A G C B Hitchcock according to methods developed by O M Miller at the American Geographical Society. Composition and editing of map by W L G Joerg. Printing by W A Briesemeister and Stanley F Smith

SENTINEL RANGE

Scale and key same as map B

High mountains contiguous beyond edge of photograph

Mt Mary Louise Ulmer
highest peak estimated 3300m

C

Photographs 39 and 40 published in Geogr Review, July, 1936 as figs 12 and 16

Finley Peninsula

Ruppin Peninsula

Turnabee → Glacier

Scripps Peninsula

Snow and ice-covered upland scattered rock outcrops (summits estimated at 1500m approx.)

approximate position of high cirque shown on photographs 13 and 14

Glacier

Casey

Cape Walcott

Miller Point

Cape Mayo

Ocean

Antarctica

relative position approximate

PROBLEMS OF WATER-BOUNDARY DEFINITION

MEDIAN LINES AND INTERNATIONAL BOUNDARIES THROUGH TERRITORIAL WATERS

S. Whittemore Boggs
U. S. Department of State

POLITICAL boundaries that pass through bodies of water within the territory of two or more nations or states present several interesting problems. No matter how complicated any land boundary may be, it can be marked throughout its entire course, and it is so marked whenever it becomes necessary. But water boundaries are characterized by peculiar problems, both of definition and demarcation. Definition of water boundaries is usually expressed in relation to their landward margins, and shore lines shift both vertically and horizontally, with melting snows, spring freshets, drought, or tides; furthermore they migrate with erosion and accretion. Likewise, demarcation questions are peculiar, generally speaking, in part because it is seldom practicable to mark the turning points of boundaries in the water and it is frequently not feasible to mark them on land by means of reference monuments and lights.

Modern political administration, however, demands a definiteness in all boundaries greater than was formerly required in rivers, lakes, and seas. If a question of national or state jurisdiction arises it should be practicable to plot the position of any water craft, perhaps at the moment of an accident or a crime, on a chart on which the boundary is shown or on which it is feasible to determine the boundary in accordance with a clear and precise definition.

Many disputes concerning boundaries emerge from the limbo of needlessly ambiguous terminology. Fortunately, the treaty negotiator, the arbitrator, and the boundary commissioner have ready to hand sufficiently precise terms and concepts for most boundary types.

We shall give attention to two types of water boundaries concerning which precise concepts appear not to have been developed, namely: (1) median-line boundaries in lakes and rivers; and (2) boundaries through territorial waters to the high sea. With reference to the first, we shall attempt to suggest a precise meaning of the term "median line"; with regard to the second, we shall suggest a type of boundary through territorial waters that is capable of general application.

Much has been written about lake and river boundaries by eminent authorities.[1] And in the literature of boundary disputes and settle-

[1] For a discussion of boundaries in lakes, straits, and rivers, see Vittorio Adami: National Frontiers in Relation to International Law, translated by T. T. Behrens, London, 1927, pp. 13–43; Paul Fauchille: Traité de droit international public, Paris, 1925, Vol. 1, Part 2, pp. 246–285, 408–580; Paul de Lapradelle: La frontière: étude de droit international, Paris, 1928, pp. 199–210, 218–219.

ments there is much to be found in the testimony of experts and the opinions of learned judges.

Water boundaries in lakes, straits, and rivers are of several distinct types; generally they follow: (1) the shore,[2] (2) the median line, (3) the navigable channel or thalweg,[3] or (4) an arbitrary geometrical line[4] such as a parallel of latitude or an azimuth line. Of these four types, the median line is least clearly defined at present.

Median-Line Boundaries

The median line is a concept relating to the horizontal plane (the navigable-channel concept relates to the vertical cross section). Various terms used in treaties, arbitral awards, and boundary-commission reports are presumably equivalent to the term "median line." The treaties between the United States and Great Britain, in 1783 and 1814, defined the boundary in the Great Lakes as "the middle" of the several lakes and water communications. The boundary in the Sabine River, according to the act of Congress admitting Louisiana as a state, 1812,[5] was defined as "a line to be drawn along the middle of said river"; and the State of Texas was authorized to extend her eastern boundary from the west bank of the same river "so as to include within her limits one half of Sabine Pass, one half of Sabine Lake, also one half of Sabine River, from its mouth as far north as the thirty-second degree of north latitude" by act of Congress in 1848.[6] The Guatemala-Honduras boundary follows the "median line" of a number of rivers and streams, including the Río Frío, the

[2] Instances of international boundaries following lake shores are not numerous, but examples may be cited: the boundary between the British and German spheres of influence in Africa, by agreement of July 1, 1890, followed the shores of Lake Nyasa and Lake Jipé; the former Austro-Italian boundary in the Trentino followed the shore of Lake Idro for a short distance. Examples of boundaries following river banks include the Motagua and Tinto Rivers (mean high-water mark on the right banks, Guatemala-Honduras arbitral award, 1933), the Morge and other streams south of Lake Geneva (French-Swiss convention, June 10, 1891), and the Sabine River (western bank, by United States-Spanish treaty, 1819, and United States-Mexican treaty, 1828, but subsequently transferred to the middle of the river).

[3] Boundaries in navigable rivers and straits very commonly follow the thalweg, or navigable channel. The United States-Canadian boundary in the River St. Croix follows "the center of the main channel or thalweg" (treaty, Great Britain-United States, April 11, 1908, Art. 2); the former Juba River boundary was in "the mid-channel (thalweg)" (protocol, Great Britain-Italy, March 24, 1891); the agreement between Great Britain and Germany, Feb. 23, 1901, respecting spheres of influence between Lakes Nyasa and Tanganyika provided: "In all cases where a river or stream forms a boundary the 'thalweg' of the same shall form the boundary; if, however, no actual 'thalweg' is to be distinguished, it shall be the middle of the bed." On the definition of the "thalweg" see Kyösti Haataja: Questions juridiques surgies lors de la révision de la frontière finlandaise entre le Golfe de Bothnie et l'Océan Glacial, *Fennia*, Vol. 49, No. 1, Helsinki, 1927, pp. 1–46; reference on pp. 9–15.

[4] Boundaries in lakes not infrequently follow geometrical lines: the boundary in Lake Victoria was made to follow "the first parallel of south latitude" (agreement, Great Britain-Germany, July 1, 1890); the United States-Canadian boundary in the Great Lakes comprises "a series of connecting straight lines defined by distances and courses," the commissioners under the treaty of April 11, 1908, Article 4, having been "authorized in their discretion" to adopt such a line in place of the curved lines adopted by the commission under Article 6 of the Treaty of Ghent.

[5] 2 Stat. [Statutes-at-large] 702.

[6] Approved July 5, 1848, 9 Stat. 245.

Quebrada Tecomapa, and the Río Managuá.[7] The German-Czechoslovakian boundary in watercourses in former German Silesia follows the middle line ("Mittellinie").[8]

The geometrical definition of "median line" as it applies to a triangle is, of course, very simple: it is a line drawn from one vertex to the middle of the opposite side. Such a line bisects the area as well as the side of the triangle; in fact, the division into two equal areas seems to be an important element of the concept. But the median line as it applies to bodies of water, with their shore-line sinuosities and their tributary inlets, is less simple. Several concepts of the "median line" have been proposed.

The report of the International Waterways Commission on the location of the boundary line between the United States and Canada through Lake Erie, signed at Toronto, January 4, 1907, stated that the expression "the middle" of the lake may mean:

(a) A line being at all points equally distant from each shore;
(b) A line following the general lines of the shores and dividing the surface water area as nearly as practicable into two equal parts;
(c) A line along the mid-channel dividing the navigable portion of the lake, and being at all points equally distant from the shoal water on each shore.[9]

We shall consider these and other concepts of the median line, not in the abstract but in the concrete, as applied to the map of Lake Erie made by the U. S. Lake Survey, Corps of Engineers, War Department.

Lake Erie as Example

We may examine first what might be called the landsman's or the shore-line viewpoint. It would perhaps seem reasonable to suppose that one might start with one of the shores of the lake and from successive points draw lines to the nearest point on the opposite shore; the line connecting the mid-points of each of these lines might be regarded as the median line of the lake. It would be a line of mid-distances measured from shore to shore. Figure 1, however, shows that this concept is quite impossible, even from one shore, and that the results from the opposite shores would be quite dissimilar.

As the second concept, we shall consider the second of the International Waterways Commission's hypothetical definitions. The idea of a median line that leaves one-half of the area on each side seems to be desirable. But, obviously, any number of lines length-

[7] Guatemala-Honduras Special Boundary Tribunal: Opinion and Award. Washington. 1933. pp. 95–98.

[8] The treaty of Jan. 31, 1930, article 1, fixes the water boundaries as the "Mittellinie," which is defined as a continuous line equidistant from the two shore lines. In case of doubt concerning the shore lines, the line of permanent grass (*ständiger Graswuchs*) or other characteristic evidences (*Merkmale*) shall be counted; if these are insufficient, the international boundary shall be the middle line of the expanse of water at low-water stage. (See *Reichsgesetzblatt*, Part 2, No. 2, Berlin, Jan. 12, 1934.)

[9] Compiled reports of the International Waterways Commission, 1905–1913, Ottawa, 1913, p. 578.

wise of the lake may be drawn, in which compensations are so made that the areas on the two sides of the line are exactly equal. A shift of the present Lake Erie boundary which transferred 20 square miles of water from the United States to Canada would result in exact equality of area for the two countries;[10] such a change could obviously be made anywhere. In other words, there is nothing specific in such a definition.

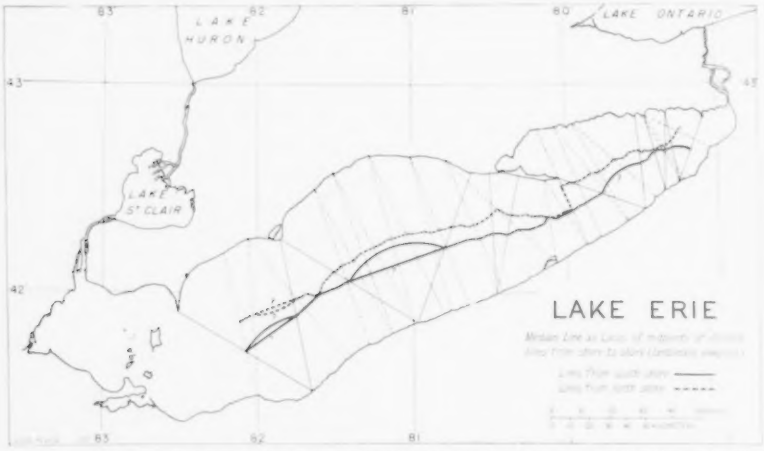


FIG. 1.—An impracticable concept of the median line (a "landsman's viewpoint"): the median line being the locus of the midpoints of all lines drawn from points on one shore to the nearest point on the opposite shore. The line differs as it is drawn from the north or the south shore, the two versions only occasionally being coincident. Compare Figure 2.

The third concept is the third hypothetical definition of the International Waterways Commission. The idea of "a line along the mid-channel dividing the navigable portion of the lake, and being at all points equally distant from the shoal water on each shore" evidently cannot be applied to Lake Erie, as there is no narrow channel of navigable water except among the islands at the western end. This definition would apply to many rivers and straits and to some lakes,[11] but it is more nearly the idea of the thalweg than a true median line. And taken as a whole it is not a precise definition in any sense.

As a fourth definition we shall consider the median line as the line every point of which is equidistant from the nearest point or points on opposite shores of the lake, river, or strait. Figure 2 illustrates how such a line is constructed. Only one such line can be drawn, and it is therefore a precise definition. In laying down such a line on the

[10] According to the U. S. Lake Survey report on the "Survey of Northern and Northwestern Lakes," War Dept., Corps of Engineers, *Bull. No. 45*, 1936, p. 335, the United States portion of Lake Erie including the Detroit River is 4990 square miles, while the Canadian share is 4950 square miles.

[11] Compare, for example, the northern end of the boundary between Finland and Norway in the Vuoremijoki; the treaty of April 28, 1924 stipulates that the frontier is "in the middle of the lakes formed by the river."

chart it is necessary to discover points which lie on the line by trial and error; but as regards any point in the lake, in order to find on which side of the median-line boundary it lies it is necessary only to swing a compass from that point on the chart to opposite shores of the lake or river in order to ascertain which shore is the nearer and, therefore, on which side of the boundary the point is situated. Difficulties may be encountered in determining how to treat islands in a

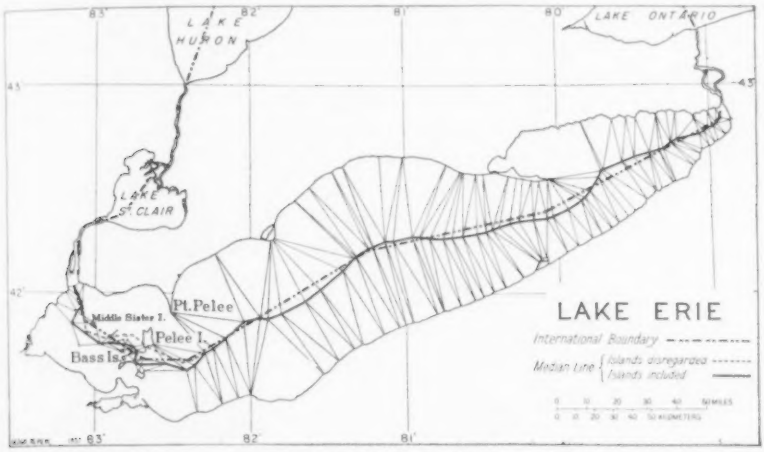


FIG. 2—The most practicable concept of the median line: the line all points of which are equidistant from the nearest points on opposite shores. Such a line is continuous, and only one such line is possible.

lake and in carrying the median line all the way to the end of a lake; but these difficulties are inherent in the problem of defining the median line and are not peculiar to this specific definition.

The geometrical principle is most readily perceived in studying parts of the lake where the shore irregularities are on a large scale, as in Lake Erie just east of Point Pelee. The median line, being equally distant from opposite shores, follows a straight line that is equally distant from two projecting points on the two shores until a third point that is equally distant is reached; then it usually proceeds in relation to one of the first two points and the new point. Each such straight line lies on the perpendicular that bisects the line connecting the two nearest points on opposite shores; in fact, the median line consists of a series of such straight lines, each of which is extended until it intersects the next. Geometrically such a median line is very simple. Actually it may display rather surprising irregularities, as in the western end of Lake Erie. But it must be remembered that the median line thus defined has a precise connotation. Indication of the boundary on published charts is therefore not essential, though it is desirable, and is practically essential if any modification of the strict median line of equidistance is adopted.

Island Complications and Other Problems

With reference to the problem of islands in a lake, it is suggested that if the sovereignty of the islands has not previously been determined, and if it be desired to apply the principle of the median line in allocating them, the first step will be to develop a median line by ignoring the islands altogether, reckoning only from the main lake shores. Such a line may traverse one or more islands, but usually more than half of an island will lie on one side of such a line, which may be regarded as determining the allocation of the entire island. The allocation of all of the islands having thus been determined, a median line may then be finally drawn midway between the islands, or between islands and mainland, simply by developing a line equidistant from the nearest points of territory of the two sovereignties. On the chart of Lake Erie (Fig. 2) the median line at the western end of the lake, drawn by ignoring the islands, is shown as a dotted line; it results in assigning the islands to the United States and Canada very much as was done by the commission under Article 6 of the Treaty of Ghent, differing only in assigning the Hen and Chickens Islands to the United States rather than Canada. The median line that takes account of the islands is shown as a continuous line, as in the rest of the lake.

An illustration of the problem of prolonging the median line all the way to the end of a lake is afforded by Lake Michigan[12] (Fig. 3). The southern end of the lake is asymmetrical in form, the axis trending to the west of south. As the median line is plotted on the chart, southwardly, it finally reaches a point that is nearer to a single point on the south shore than to any two points on opposite shores, to the right and left; a straight line to that point naturally completes the median line.

In defining a boundary that is to follow the median line in a lake, river, or strait, it should be remembered that the definition is not

[12] Michigan Territory was organized as a territory June 30, 1805, the western boundary extending "from the southern bend or extreme of Lake Michigan . . . through the middle of said lake to its northern extremity . . ." (2 Stat. 309). The northern boundary of Indiana, by the enabling act approved April 19, 1816 (3 Stat. 289), eastwardly from the meridian of the town of Vincennes, follows "an east and west line, drawn through a point ten miles north of the southern extreme of Lake Michigan . . ." The boundaries of the state of Illinois, by resolution approved April 18, 1818, extend in Lake Michigan east along the northern limit of Indiana "to the middle of Lake Michigan; thence, north along the middle of said lake, to north latitude forty-two degrees thirty minutes . . ." (3 Stat. 429). Wisconsin was established as a territory by an act approved April 20, 1836, being "bounded on the east, by a line drawn from the northeast corner of the State of Illinois, through the middle of Lake Michigan, to a point in the middle of said lake, and opposite the main channel of Green Bay . . ." (5 Stat. 10–11). These are all of the essential successive steps in the delimitation of the Lake Michigan boundary "through the middle of said lake," except for the question of the location of the northernmost point "opposite the main channel of Green Bay"; the boundary through Green Bay to the midde of Lake Michigan was determined by the Supreme Court in a decree dated March 16, 1936 (297 U. S. 547–552). The boundary line in the middle of Lake Michigan is shown on various official maps, but unfortunately such maps do not agree with one another; an attempt is made in the illustration (Fig. 3) to apply to Lake Michigan the rigid definition of the median line which is herein proposed.

complete unless the shores or banks are defined by specifying the stage of the water, as "mean high water" or "mean low water."

The median line is less used as a boundary than formerly, so far as rivers are concerned.[13] In lakes it is frequently the most desirable boundary; but in rivers and streams, particularly if navigable by any water craft, since about 1800 the boundary has more often been defined as "the line of greatest depth or the stream line of the fastest current, which is called in German 'thalweg.'"[14]

In order to give definiteness to the meaning of the term "median line" when employed in the future, in treaties, boundary commission reports, etc., it is therefore suggested that it might be advisable to insert a definition, such as "the median line being a line every point of which is equidistant from the nearest points on the shores of the two respective sovereignties; the shore line being the line of mean high water [mean low water, or other indication of stage of the water]."

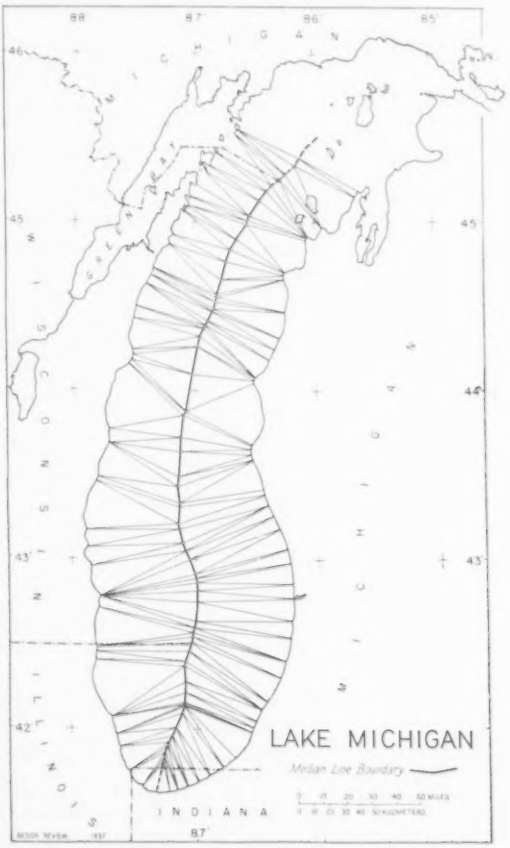


FIG. 3—The median line in Lake Michigan, being the line all points of which are equidistant from the nearest points on opposite shores.

The Michigan-Wisconsin boundary in Green Bay and to the middle of Lake Michigan, according to the decree of the U. S. Supreme Court of March 16, 1936, is also shown (as a broken line).

BOUNDARIES THROUGH TERRITORIAL WATERS

The second type of water-boundary problem relates to the boundary between two nations or states, extending from the coast through

[13] On this point see Adami, *op. cit.*, pp. 15–20.

[14] *Ibid.*, pp. 16–17; Haataja, *op. cit.*, p. 8.

territorial waters to the high sea.[15] Treaties, awards, and laws sometimes omit to define these boundaries, the line frequently being defined as if the boundary terminated at the coast.[16]

The desirability of defining the water boundary all the way to the high sea was expressed, for example, in the treaty between the United States and Great Britain, signed February 24, 1925; Article 3 observes:

> And whereas it has been found by the surveys executed pursuant to the said Treaty of May 21, 1910, that the terminus of the boundary line defined by said Treaty at the middle of Grand Manan Channel is less than three nautical miles distant both from the shore line of Grand Manan Island in the Dominion of Canada and from the shore line of the State of Maine in the United States, and that there is a small zone of waters of controvertible jurisdiction in Grand Manan Channel between said terminus and the High Seas . . .

The treaty therefore prescribed a single straight line, of specified length and direction, extending from the 1910 boundary terminus to the high sea (Fig. 4).

Two methods of delimiting the territorial waters between two contiguous states are described by Lapradelle.[17]

> [A line] the direction of which will be determined with relation to the land boundary or with relation to the coast line.
>
> In the first case, the maritime boundary line will be considered an extension of the land boundary [i.e., the last straight-line section of the land boundary], and will be traced in the same direction.
>
> In the second case, the maritime boundary will be considered by itself, independent of the land boundary line, except at its point of contact with the coast. Its direction will be perpendicular to the general direction of the coast line.[18]

Before considering the merits of these two methods it is desirable to study a typical situation graphically. The best way to visualize the problems involved in delimiting the territorial seas of contiguous

---

[15] For a discussion of the boundary between territorial waters and the high sea, see S. W. Boggs: "Delimitation of the Territorial Sea; the Method of Delimitation Proposed by the Delegation of the United States at The Hague Conference for the Codification of International Law" (with illustrations) in *Amer. Journ. of Internat'l. Law*, Vol. 24, 1930; pp. 541–555.

[16] The following examples of boundaries defined through the territorial waters to the high sea may be cited: award of the Permanent Court of Arbitration, at The Hague, October 23, 1909, in regard to the maritime boundary between Norway and Sweden (the "Grisbadarna case"); the Delimitation Commission, Danish-German boundary, in its report of September 3, 1921, defined the water boundary both to the North Sea and the Baltic Sea, comprising a series of straight lines, the last of which in each instance extends "to the open sea"; the Italo-French boundary extends to a distance of three nautical miles and is marked by reference marks on the land (Italy. *Esercito.* Storia Documentata dei Confini del Regno d'Italia, Vol. 1: Confine Italo-Francese, Rome, 1919; pp. 220, 397–398).

[17] Lapradelle, *op. cit.*, pp. 215–216 (transl.). Adami, *op. cit.*, p. 50, states that the boundary through territorial waters is a "hypothetical line perpendicular to the coast starting at the point where the land boundary meets the sea."

[18] This was in effect the method applied in the award in the Norwegian-Swedish arbitration, in the Grisbadarna case, referred to. This method was regarded as "much more in accord with the ideas of the seventeenth century" [the treaty of 1661]. The award states: "The general direction of the coast, according to the expert and conscientious survey of the tribunal, swerves about 20° westward from due north," and the boundary was stipulated to be drawn in a direction W. 19° S. [i.e., S. 71° W.] . . . "until it reaches the high sea." (Hague. Permanent Court of Arbitration. The Hague Court Reports . . . [1st ser.], James Brown Scott, edit., New York, 1916, pp. 129, 132–133.)

countries is to describe, on a chart, the seaward limit of the territorial waters of each country as if the other did not exist. These limits will be the envelope of the arcs of circles of three nautical miles' radius drawn from all points on the respective coasts. The two curves will

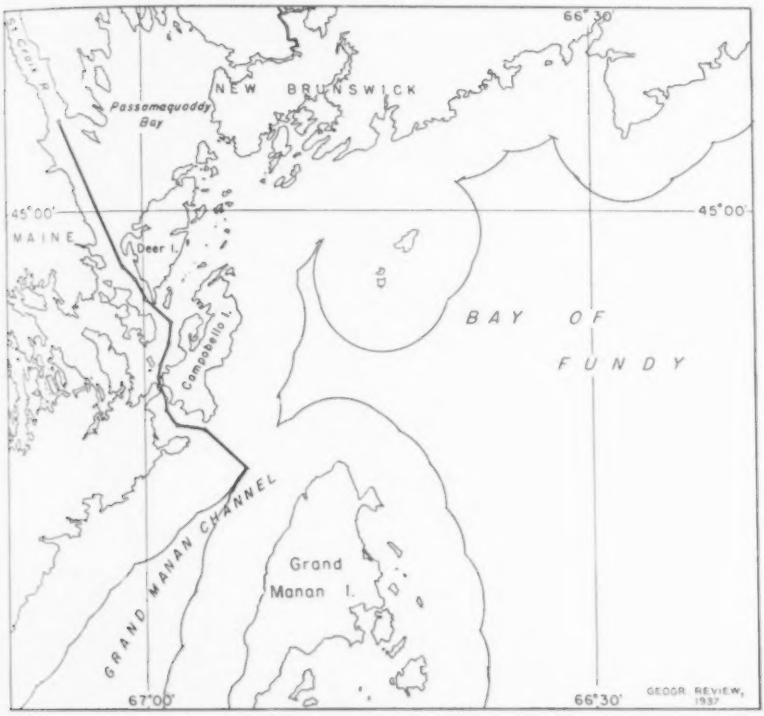


FIG. 4—An example of a properly completed water boundary. By treaty of February 24, 1925, the boundary between the United States and Canada was extended from the terminus established in 1910 in the middle of Grand Manan Channel. A single line was added, in a direction S. 34° 42′ W., a distance of 2383 meters to the high sea, at a point three nautical miles from the nearest shores of American and Canadian territory.

intersect at a point which may be exactly three miles, but is often more than that distance, from the terminus of the land boundary on the shore (see the point B on Fig. 5). This point of intersection of the curves is the normal terminus of the water boundary; it is a "triple point" in the boundary sense, being naturally the point at which three boundaries should meet; namely, the boundary between the territorial seas of the two contiguous countries and, for each of the two countries, the boundary between its territorial sea and the high sea.

It will now be observed that the two methods of delimiting the international boundary through the territorial sea that are cited above are both somewhat defective; they are illustrated on Figure 5 as the

lines AC and AD. The continuation of the last land boundary section is open to the objection that it is usually accidental in direction, having no relation to the necessities of delimiting a water boundary. The second type of line is open to criticism because it is not always feasible to determine the general trend of the coast: how much coast should be taken into consideration for this purpose—a distance of three miles

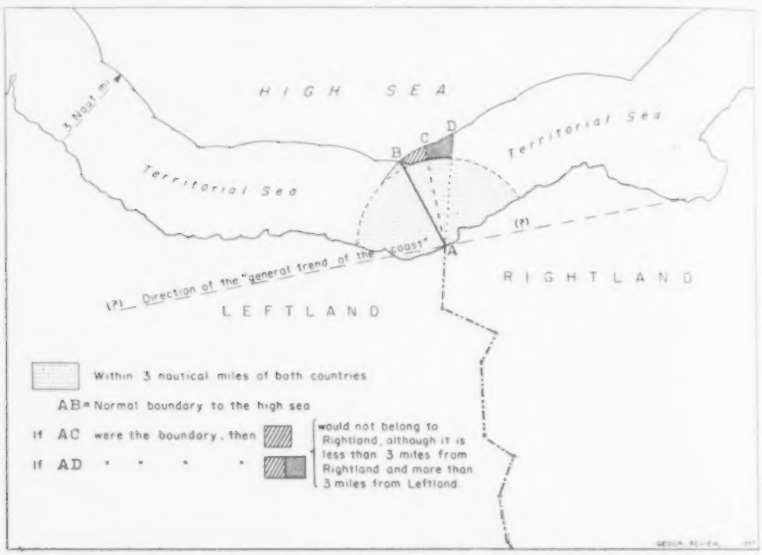

HIGH SEA
3 Naut. m.
Territorial Sea
Territorial Sea
B
C
D
A
(?)
(?) Direction of the "general trend of the coast"
RIGHTLAND
LEFTLAND
Within 3 nautical miles of both countries
AB = Normal boundary to the high sea
If AC were the boundary, then
If AD " " " "
would not belong to Rightland, although it is less than 3 miles from Rightland and more than 3 miles from Leftland.

FIG. 5—The international boundary through the belt of territorial waters (or "territorial sea") from the coastal terminus of the land boundary to the high sea. This is an example of the simple type, where there are no islands or highly irregular coast line. The most reasonable boundary is the line AB, the point B being the intersection of the envelopes of arcs of three-mile radius drawn from all points on the shores of the two countries, "Leftland" and "Rightland" respectively. Two other definitions of the international boundary are sometimes employed: (1) the extension of the last section of the land boundary or (2) a line perpendicular to "the general trend of the coast." Both of these are objectionable, certain areas (ruled shading) being waters of controvertible jurisdiction.

on each side of the land boundary, or five miles, or twenty miles? And how average the sinuosities so as to ascertain the general trend?

Boundaries delimited by both methods present further difficulties which are identical in character. On Figure 5 it will be seen that, if the boundary terminates at either C or D,[19] there will be a zone of waters between AC or AD (as the case may be) and the line AB that needlessly constitutes a zone of waters of controvertible jurisdiction.

[19] Sometimes the boundary is not defined as terminating at the high sea, but at a point three nautical miles from the terminus of the land boundary. In many instances such a point is not on the high-sea boundary, because it is less than three miles from some nearer point on the shore. The Canal Zone boundary in the Bay of Panama is so defined in the convention of September 2, 1914, Article 4, extending three miles from mean low-water mark at Punta Mala, in a direction S. 72° 14′ E. The end of that line is, however, only about 1.5 miles from the island of Perico and about 2 miles from the nearest point in the city of Panama; and it is approximately 1.6 nautical miles from the nearest point on the high sea—the natural "triple point," which is just three miles from the nearest land of both the Republic of Panama and the Canal Zone.

These waters (shaded on the diagram) do not belong to "Rightland" because they are to the left of the boundary; they should not belong to "Leftland" because they are more than three miles from its shores; and yet they are not part of the high sea because they are less than three miles from "Rightland."

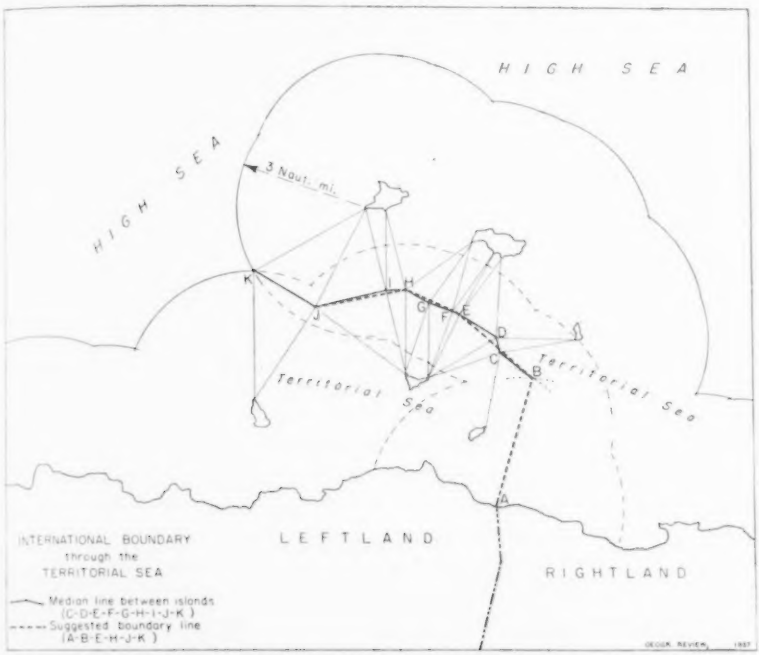


FIG. 6—A reasonable water boundary through an island zone to the high sea. The line C-D-E-F-G-H-I-J-K is a median line between nearest points on the shores of the islands belonging to "Leftland" and "Rightland." A simpler line, A-B-E-H-J-K, approximating closely the median line, would constitute a reasonable boundary from the mainland coast, through territorial waters, to the high sea.

It seems clear, therefore, that the normal terminus of the territorial-sea boundary is that point which is three miles from the nearest land of the two sovereignties, and that the simplest boundary through the territorial sea is a straight line[20] from the land boundary to that normal terminus at the high sea. There are, of course, instances in which a single straight-line boundary will not serve, but in such instances it would seem that the boundary should constitute a series of straight lines, the last of which should end at the normal high-sea terminus.

The boundary in Grand Manan Channel, defined by the 1925

[20] Lapradelle observes that in certain cases the last part of the land boundary is a river, and that, "in fact, the river does not really terminate at its mouth, but is extended into the sea: an exterior thalweg follows the interior thalweg" (*op. cit.*, p. 217). In such cases the boundary may well follow the center of the navigable channel.

treaty referred to above, illustrates this principle, although the line begins in the middle of the channel instead of at the terminus of a land boundary. Figure 4 shows how the high-sea terminus of the boundary was determined—by describing the three-mile limits of each country as if the other did not exist and taking the intersection point as the seaward end of the water boundary. Without explaining that this was the method employed, the treaty simply provided that the last section of this water boundary should be a line 2383 meters in length extending in a direction S. 34° 42′ W. from the terminus of the 1910 boundary.

Island Complications

There remains only one further type of case in delimiting the boundary through the territorial waters of contiguous states, namely that in which there are complications due to the existence of islands or of a highly irregular coast line. This is illustrated in Figure 6. It would appear that in defining the first section of the boundary, beginning at the shore line, the best method is to describe three-mile arcs from the two mainland coasts, ignoring the islands, and to take their intersection as the terminus of the first section of the boundary, AB. From that point the normal boundary line is one which is equidistant from the islands of the two sovereignties; in other words it is constructed on the chart exactly as the median line in a lake or river is constructed. If this line is more complicated than seems desirable, an arbitrarily simplified approximation may be decided upon.

Such a line terminates at the high sea at the natural "triple point" and is approximately equidistant from the land territory of the two states throughout its entire course. Except for the turning point nearest the mainland and the high-sea terminus, each turning point of the boundary is a point that is equidistant from three points of land. In defining the boundary, therefore: (1) each turning point may be defined by indicating the three points from which it is equidistant; (2) each turning point may be indicated by latitude and longitude; or (3) the line may be defined by directions and distances from the initial point. It is believed that this method of delimiting and defining boundaries through the territorial sea is of general applicability in relation to international water boundaries from the coast line of contiguous states to the high sea.

WATERWORKS INTAKES OF THE GREAT LAKES

Bert Hudgins
Wayne University, Detroit

WHEN cities grow beyond the village stage, water supply becomes a major problem. Whatever the source of supply —springs, artesian wells, surface wells, streams, or lakes— the problem is one of securing a sufficient quantity of water of a pure enough quality. The cities of our country each have their own particular problems because of the variety of combinations in the physical factors concerned. Columbus, Ohio, has had to construct a water-softening plant, said to be the largest in the country, to reduce the high mineral content of its water. St. Louis' task is to settle the sediments from the muddy waters of the Mississippi and Missouri Rivers. Los Angeles has had to go beyond its arid surroundings to a distant source. New York has an expensive pumping system to gain sufficient head of water for its tall buildings. Atlantic City must consider the eventuality of salt-water contamination.[1] Since the Great Lakes constitute the largest fresh-water bodies on earth, it would at first appear that cities located on the border of these lakes would have but little difficulty in securing a suitable water supply. Such is not the case, as it is the purpose of this paper to show.[2]

Physical Character of the Great Lakes

The combined drainage basin of the Great Lakes is 298,000 square miles, of which about 95,000 square miles, or one third, consists of water surface of the lakes themselves. The average annual precipitation of the Lakes basin is 30 inches, its variations from year to year causing low and high water level in the lakes.[3] The fluctuation in lake level due to low precipitation is rarely more than two feet, and a rather constant flow of about 210,000 cubic feet a second is maintained out of the St. Lawrence,[4] a quantity sufficient to supply sixty times the entire population of the United States.

The depths of the lakes range from a maximum of more than 1000 feet in Superior to not more than 210 feet in Erie. Nearly everywhere opposite large urban centers 40-foot depths can be reached within

[1] D. G. Thompson: Ground-Water Problems on the Barrier Beaches of New Jersey, *Bull. Geol. Soc. of America*, Vol. 37, 1926, pp. 463–474.

[2] J. W. Ellms: Water Purification and Sewage Disposal on the Great Lakes, *Scientific Monthly*, Vol. 33, 1931, pp. 423–427.

[3] See graphs of lake levels, reproduced in P. W. Henry: The Great Lakes-St. Lawrence Waterway, *Geogr. Rev.*, Vol. 17, 1927, pp. 258–277, and in Mark Jefferson: Variation in Lake Huron Levels and the Chicago Drainage Canal, *ibid.*, Vol. 20, 1930, pp. 133–137.

[4] Report of the Engineering Board of Review of the Sanitary District of Chicago on the Lake Lowering Controversy and a Program of Remedial Measures, Part II: The Technical Bases for the Recommendation of the Board of Review, Jan. 23, 1925.

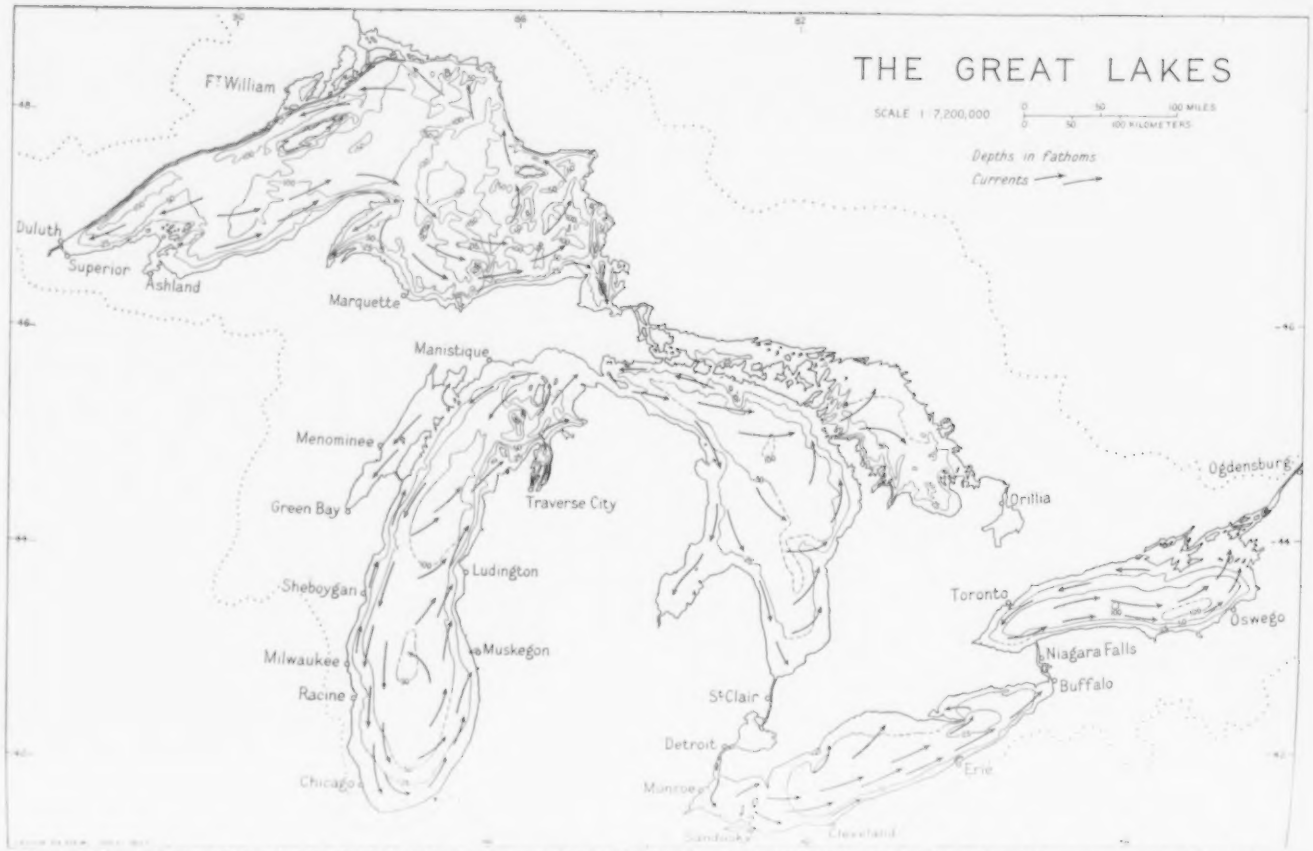


FIG. 1.—Map of the Great Lakes showing the drainage basin, important cities on the lake shores, depths (in fathoms), and general trend of currents. Scale, 1 : 7,200,000.

a few miles from shore. Superior and Green Bay, Wis., have shallow water for considerable distances out, and these are the only important cities on the Lakes that do not derive their water therefrom. Green Bay has an artesian supply from rock at a 900-foot depth, while Superior takes its supply from 150 shallow wells in the sand bar known as Minnesota Point, which encloses the harbor of Duluth-Superior.

Currents produced by wind in the Great Lakes take the form of rather persistent counterclockwise eddies in each basin. The currents, as observed by bottle floats and other means, are fairly pronounced and regular on the south and west sides of the lakes, ill-defined on the north and east sides. The current two miles offshore from Cleveland flows eastward at the rate of four miles an hour, which is faster than the flow of some of the world's large rivers. The United States, with numerous large urban developments, takes water supplies from the south and west shores, where lake currents are well defined. Canada, on the north and east, has few urban developments bordering the lakes.

Location of Intakes

Since the Great Lakes are large fresh-water bodies, waterworks intakes placed far out in the lakes would normally provide fairly pure water, though even here one has to reckon with the dangers of pollution from passing vessels and from storm-driven polluted shore waters. But the expenses of constructing and maintaining an intake far out and in deep water are so great that in preference a less pure water is taken from an intake placed reasonably close to shore and made potable by filtration and treatment.

There are two types of intakes used in the Great Lakes—the exposed-crib and the submerged intake. The exposed-crib is built above water, is usually made of stone or cement, and is lighted as a guide to navigation. Within and below this structure water is permitted to enter through control doors arranged at various depths.[5] This type of intake is suitable for shallow water, where the superstructure serves as a protection from waves, ice, and vessel anchorage. Sometimes a sentry is stationed on the crib to warn of any impending danger to the water supply. The exposed-crib was the first type of intake to be used by Great Lakes cities; and Chicago, Cleveland, Buffalo, Montreal, and several other cities continue to use it.

The submerged intake consists of a large dome-shaped capping of the water main extended into the lake. It is generally made of sheet iron and perforated with numerous holes. This dome is protected by a submerged structure usually of 2-by-12-inch planks standing on edge and placed one inch apart. With recent advances in engineering

[5] Data used in much of this study were furnished by a questionnaire sent to 26 large cities on the Great Lakes.

the trend is towards extending the intake farther from shore and using the submerged type. But no matter what the type of intake used, it must rest on a firm foundation on lake bottom. Probably about 100 feet is the maximum depth for economic construction.

In choosing a location for an intake each case must be studied separately and the factors affecting purity of the water and economy of construction and maintenance considered and weighed one against the other. The physical factors to be considered are location with reference to mouths of debouching streams, lake currents, storms and waves, ice of all kinds, depth of water, slope and material of the lake bottom, and paths frequented by vessels.

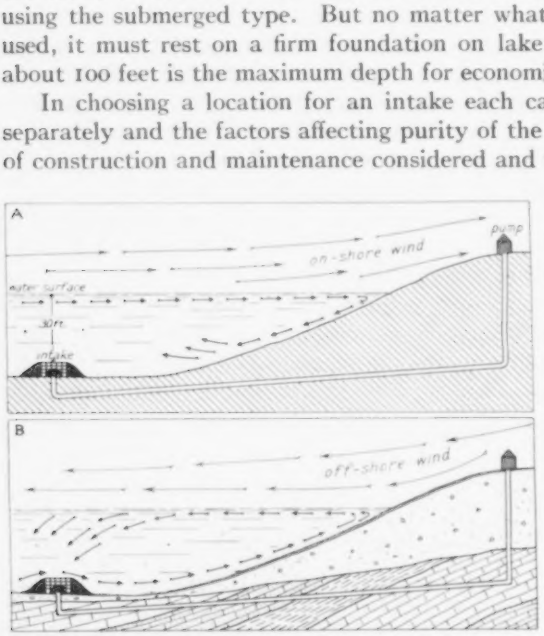


FIG. 2—A generalized diagrammatic section from shore to waterworks intake to illustrate effects of (A) onshore and (B) offshore winds in bringing shore pollution to the intake.

B also presents a diagrammatic sketch of a submerged intake, showing the intake tunnel leading to the shore pump in solid rock and the riprap surrounding the timbers that cover the head of the intake pipe.

MOUTHS OF STREAMS

Early explorers and settlers found the mouths of streams, up which they could direct their canoes, good locations for trade, and towns grew up at such sites—Cleveland on the Cuyahoga, Erie on the Cascade and Mill Creeks, and Oswego, Sandusky, Milwaukee, and Chicago on their respective rivers. Scarcely a creek of considerable size enters the Great Lakes on the United States side but has an urban development at its mouth. As long as population density, particularly population density inland, was small, people of the port town obtained water supplies from surface wells or from the stream. With growing population inland, in the drainage areas tributary to the Great Lakes, and at lake ports, the mouths of such streams have become open sewers carrying wastes into the lakes. Cleveland, an industrial center and lake port with a population of about 900,000, takes a water supply from Lake Erie at a distance of not more than a few miles from the exit of the Cuyahoga River. In placing this intake the waterworks engineers had to estimate the possibilities of contaminated water from sewage of Cleveland's own population and from Akron and numerous small urban centers of the Cuyahoga basin—altogether

a population of about 1,500,000. The entire drainage basin of the Great Lakes contains probably 12,000,000 people contributing sewage and industrial wastes, a large part of which eventually reaches the lakes and endangers the water supplies of lake ports. The problem becomes one of locating the intake so that sewage may be diffused and carried away by currents. The intake is not placed directly opposite the mouth of the river but on the side that benefits from the general current. On the south side of Lake Erie the current is fairly persistent and moves eastward. Hence waterworks intakes are located to the west of the harbor and river mouth, and sewage outfalls to the east, as in the case of Cleveland and Erie and also at Oswego, N. Y., where currents on the south side of Lake Ontario flow eastward. On the west shore of Lake Michigan the current is from the north, and the intakes are invariably placed north of the river mouth, as at Racine, Wis., at Milwaukee, where the intake is six miles north of the mouth of the Milwaukee River, and at Chicago, where, before diversion, water was taken from north of the exit of the Chicago River and sewage outfalls were directed toward the south.

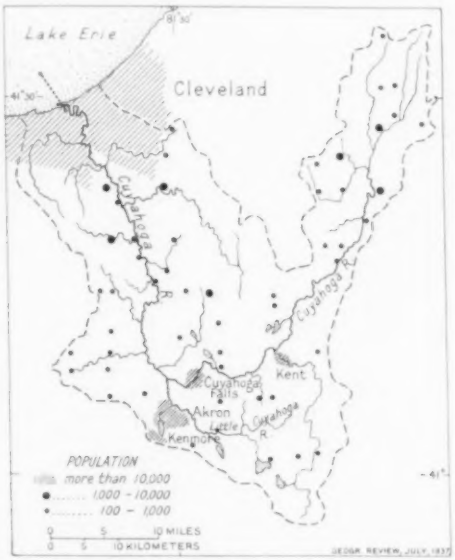


FIG. 3—The Cuyahoga Drainage Basin. This map illustrates the problem of placing a waterworks intake in one of the Great Lakes so as to avoid pollution from a stream.

WINDS, WAVES, CURRENTS AND FLOODS

The general flow through the lakes is negligible compared to currents produced by wind action.[6] For example, with an assumed uniform flow in a cross section of Lake Erie opposite Cleveland, the current would be only about 35 feet a day, if there were no winds. It has been estimated that surface currents in the lakes will have, on the average, a velocity of about five per cent of the velocity of the wind. Duration of the wind, as well as velocity, materially affects the water currents. Onshore winds tend to pile up the water along shore, creating an undertow away from the shore to the body of the

[6] J. W. Ellms: Lake Erie and the Niagara River. *Amer. Journ. of Public Health*, May, 1927, p. 458.

lake. Under such conditions polluted water from the shore or from sewage outfalls may be swept far out into the lake. On the other hand, offshore winds will carry surface water away from shore and will bring an undercurrent of pure water from the lake towards shore. If the intake is in deep water it receives a pure water at the same time that the surface water is polluted. If an intake is far out it is, of course, less

FIG. 4—An aerial view of the Detroit River, Detroit, Mich. The light color in midstream represents turbid water created by dredging in Lake St. Clair above.

likely to receive impure water from offshore or onshore winds. Of the 26 large cities taking water from the lakes the average distance of intake from shore is one and a half miles, and the greatest distance is about five miles. On the large lakes waves may at times be as high as 20 feet and move material on the lake bottom at a depth of 50 feet. For this reason alone it is desirable to have intakes at a depth of 30 feet or more.

Heavy rains bring danger of contamination because streams in flood flush down much sediment and sewage and, if aided by winds, may reach far out into the lake. Especially is this true in the spring of the year when ice, contaminated perhaps by sewage, is melting and breaking up. Operators of filtration plants need to be most alert at these times to note any increase in sediment and bacteria count warranting extra doses of alum for coagulation and settling and chlorine for killing bacteria. Filtration records at Chicago, Detroit, Cleveland, and Buffalo all show increases in bacteria count

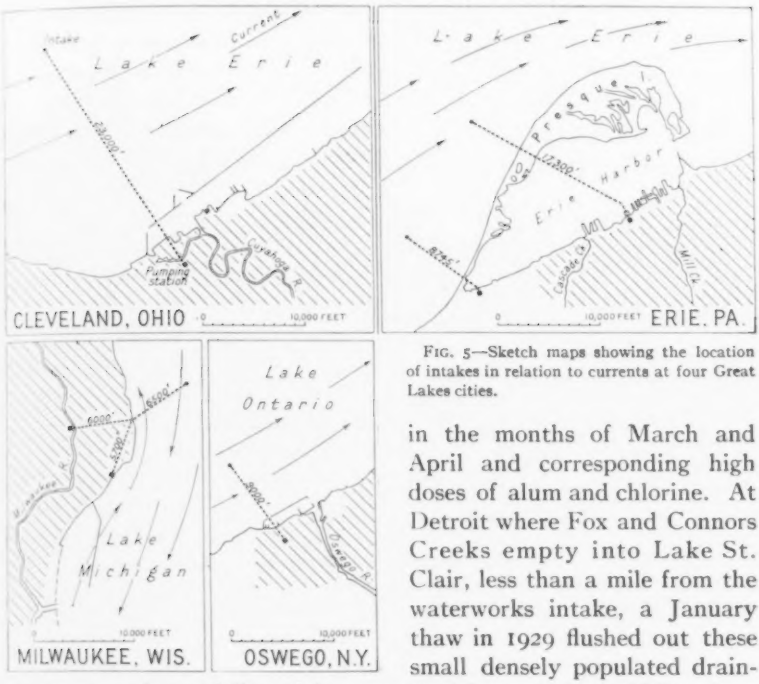


FIG. 5—Sketch maps showing the location of intakes in relation to currents at four Great Lakes cities.

in the months of March and April and corresponding high doses of alum and chlorine. At Detroit where Fox and Connors Creeks empty into Lake St. Clair, less than a mile from the waterworks intake, a January thaw in 1929 flushed out these small densely populated drainage areas and was followed by a marked increase in turbidity, bacteria, and B coli count at the filtration plant, necessitating increased dosage of alum and chlorine (Fig. 6). A single rain and wind storm at Detroit in December, 1927, is estimated to have cost the city $550 in extra alum alone.[7]

Ice of Various Types

Ice formed on the streams tributary to the lakes, then flushed into the lakes during the spring, is, as we have noted, a factor to be considered. Ice formed on the lakes themselves is, however, far more important in the locating of an intake. Water flow into the intake may be reduced or even cut off by stoppage of the ports of the intake. Lake ice occurs in three forms, differentiated by method of formation, portion of the water where formed, and structure—i.e. sheet ice, frazil ice, and anchor ice. Sheet ice forms on the surface of the water and increases in thickness on the under side. Sheet ice may be as thick as 38 inches, as was once reported in the harbor of Duluth, or it may be only a few inches thick in harbors as far south as Milwaukee, Chicago, or Ashtabula. The highest monthly average thickness of ice for a twelve-year period, 1900–1912, was 26.4 inches at Duluth,

[7] Bert Hudgins: Weather Conditions as Factors in the Filtration of the Water Supply at Detroit, Mich., *Monthly Weather Rev.*, Vol. 58, 1930, pp. 354–362; reference on pp. 357–358.

11.8 at Port Huron, 22.5 at Escanaba, Mich., 11.8 at Oswego, 9.1 at Erie, Pa. At first it was thought the Great Lakes froze over solidly, but recent studies show that this is not the case except in the shallow parts. They freeze around the edges and in harbors and connect near-by islands to the mainland, but probably two thirds of the lake surface remains open water during the average winter. The

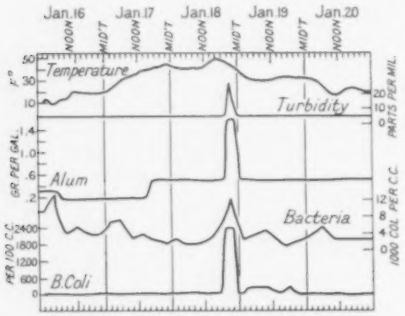


FIG. 6

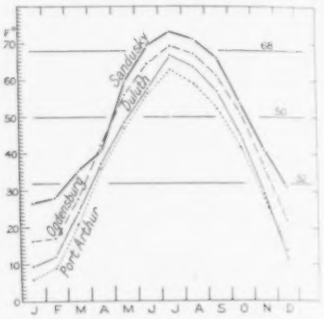


FIG. 7

FIG. 6—Graph illustrating the effect of a January (1929) thaw at Detroit in bringing polluted ice water from the lake and river shores upstream.

FIG. 7—Temperature graphs for four Great Lakes cities showing contrasts in the northern, eastern, western, and southern parts of the Great Lakes.

ice is broken up by waves, wind, and currents and driven in great fields about the lakes, particularly in late winter and spring.[8] It is sometimes driven on shore and piled up as high as 50 feet in shallow water, or it may ground in water as much as 50 feet deep. The Chicago intakes have experienced ice jams piled up 25 feet high against the cribs and extending to lake bottom, 50 feet, seriously obstructing the intake. Cleveland, Detroit, and Erie have all reported similar cases. The danger here lies not only in bringing a contaminated water but in actually stopping the city's supply.

Anchor ice forms on the bottom of a body of water as a result of cooling of the bottom by radiation. It may grow by attaching to itself ice cakes or slush ice carried downward by currents. This form has proved very troublesome in Canadian rivers and lake borders, as very large quantities may be released from the bottom to float to the surface in a limited time, thus clogging waterworks intakes. Niagara Falls, Sandusky, Detroit, and Ogdensburg report such cases.

Frazil ice, also called needle ice or slush ice, is frequently confused with or called anchor ice, though the method of formation is different. Frazil ice is a surface formation made up of needles or spicules that form when the surface is cooled below freezing but where agitation prevents the formation of sheet ice. It is always formed in an open

[8] J. W. Freeman: Regulation of the Great Lakes, Sanitary District of Chicago, 1926, p. 91.

flowing channel or in a lake disturbed by wind and currents. It ceases to develop when sheet ice covers the surface. The danger from frazil ice is that currents carry it downward where it may be drawn to the intake. Nearly all intakes for water in the Great Lakes experience this trouble.[9] The best place for locating the intake to avoid frazil ice is in a quiet bay with water at least 30 feet in depth, where a surface ice will freeze over and remain through the winter months.

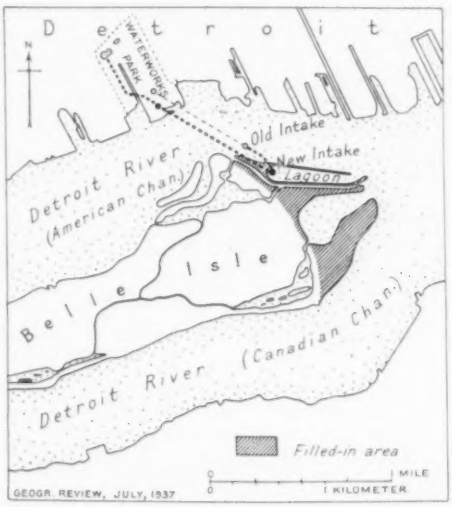


FIG. 8—Intake lagoon at Detroit. An arrangement intended to secure a purer water from the channel of the river and to prevent trouble with ice at the intake.

Many intakes are protected from stoppage of water by frazil ice by the erection of movable screens over the portholes of the intake. Sometimes an arrangement is made for enlarging the size of portholes, and sometimes intakes are guarded by men who keep slush ice away from the ports with poles. Even electricity has been resorted to for heating and melting slush ice at the intake. Detroit has a unique device for combating ice at the intake, one which may be used in future construction of waterworks intakes in the Great Lakes. It consists of a mile-long artificial lagoon on the shore of Belle Isle where the water of Lake St. Clair is brought in and allowed to freeze over solidly on the surface. A submerged-type intake is placed 30 feet below surface at the lower end of the lagoon.

The deeper the intake the less is the danger of stoppage by ice of all kinds. The average depth of twenty-six intakes studied in the Great Lakes is 38 feet.

SLOPE AND MATERIAL OF LAKE BOTTOM

The material of the lake bottom is a factor of consequence in locating water intakes. Almost everywhere throughout the lakes the bottom is composed of oozy mud and clay, with much sand or even gravel, if near stream mouths. To avoid great quantities of sediment in a water supply, openings to the intake should be placed four or five feet above the bottom. At Port Arthur the lake bottom is solid rock. This affords a good foundation for either the exposed-crib or the submerged intake, since each must rest on the lake bottom.

[9] Several instances are quoted in H. T. Barnes: Ice Engineering, Montreal, 1928.

Solid rock may be expensive to tunnel through, in order to lay water mains from shore shaft to the intake, as at Duluth. However, regardless of the fact that glacial till is about 100 feet thick in the Lower Lakes region, engineers find that it offers difficulties. It contains water and sand pockets and may ooze in, suddenly closing a tunnel under construction. This is particularly hazardous in driving tunnels under river or lake bed. Detroit engineers found it most economical, in constructing a water main from the pumping plant on the shore to the lagoon intake, to dig a shore shaft 110 feet deep, passing through glacial clay and entering well into Dundee limestone. From the base of this shaft a tunnel was driven through solid limestone for one and a half miles under the river and lake to the lagoon where it was connected with the submerged intake. Tunneling in the limestone was relatively free from water seepage and gas collection. The tunnel stood up well, without danger of caving in, and afforded a position for the water main out of reach of anchors or vessels. Detroit, Chicago, Milwaukee, and Duluth have water mains connecting intake with shore shaft, partly or entirely in deep rock far below lake bottom.

Lake Traffic

A common method of laying water mains from intake to shore shaft in early days was to lay cast-iron pipes on lake bottom. Many of these still exist in waterworks of the Great Lakes. They are, however, always in danger of being disturbed by anchors of vessels. Walkerville, now a part of Greater Windsor, Ontario, had its entire water system put out of commission a few years ago when a heavily loaded ore boat grounded on the submerged intake and water main. Erie, Pa., has erected a new intake to the west of the old one, partly to be out of the way of vessel traffic and danger of disturbance.

AN AVERAGE SLOPE MAP OF SOUTHERN NEW ENGLAND

Erwin Raisz and Joyce Henry
Institute of Geographical Exploration, Harvard University

DRIVING along one of the wide valleys of New England one cannot escape noting how distinctly does the slope of the land control land utilization. Plowed fields occupy the flat bottoms, and as the slopes become steeper on the flanks of the valley we find in succession hay fields, stony pasture, and forest (Fig. 1). The lines of separation are distinct and can be followed for miles. The angles of slope separating the cultivation types vary somewhat under the pressure of farming population—steeper slopes are cultivated in more densely settled areas—but within limits these angles can be determined. It should be noted, however, that most of New England's land is not utilized to its limits; in many places even the best bottom lands are left in forest.

The absolute elevation above sea level is of slight direct influence on cultivation in southern New England; it is otherwise with relative relief, which varies greatly and does not depend on absolute elevation. Anyone who is familiar with the rugged relief of the granitic ledges near Gloucester or even the Middlesex Fells near Boston will realize that steep slopes are possible where even the highest peak does not rise over 200 to 300 feet.

The problem of defining quantitatively the average slope of the land, or its relative relief, has been discussed by many European authorities, and lately in the United States new attention has been called to the subject by the map of the relative relief of Ohio by Guy-Harold Smith.[1]

Experiments in Method

The method applied by Smith was briefly as follows: each topographic sheet was divided into rectangles of five minutes of latitude and five minutes of longitude, roughly 25 square miles. For each rectangle the difference between the highest and the lowest point was noted and plotted on a small-scale base map on which isopleths were drawn for each hundred-foot relative relief, roughly designating areas of the same average slope. The resulting map gives such a good portrait of the relative relief of Ohio that a similar map of New England was attempted by the authors.

[1] Guy-Harold Smith: The Relative Relief of Ohio, *Geogr. Rev.*, Vol. 25, 1935, pp. 272–284, includes a discussion of the concept and of the chief European studies. Reference is also made to the recognition of the importance of slope in detailed land-utilization studies, and Finch's Montfort study is cited as an example.

George B. Cressey has prepared an average slope map of Chekiang Province, China, based on somewhat similar principles.

The first essay embraced the whole of New England. It was soon apparent, however, that the resulting map was not satisfactory. Much of the cultivated land of New England is in valleys, the width of which rarely exceeds a few miles. As such a valley rarely ever occupies an entire five-minute rectangle and as the deep valleys rather increase than decrease the difference in elevation, the most valuable flat lands

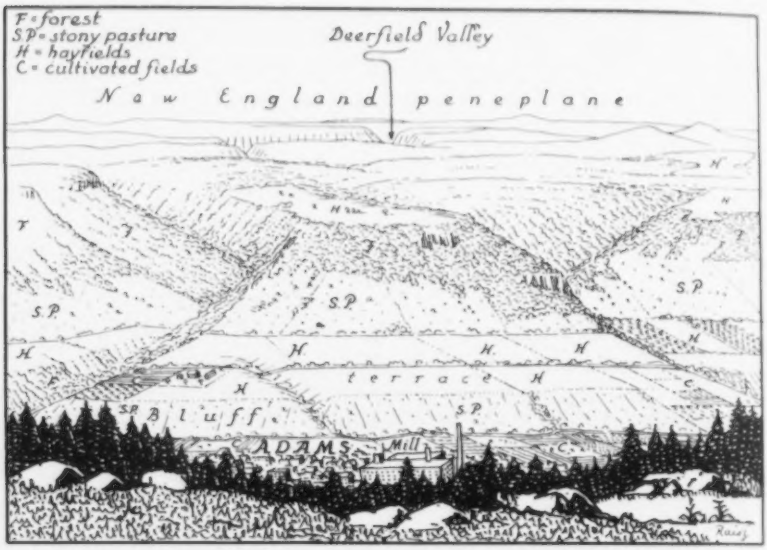


FIG. 1—Looking east from Mt. Greylock, Mass. Cultivated land in the bottom and on flat terraces; hayfields on gentle slopes; stony pasture and forest merge into each other on steeper slopes.

of New England were not represented on the map. Other common features of the New England topography are small isolated knobs sticking out steeply from relatively flat surfaces. These erosion remnants often do not occupy more than a few square miles but give a very high index number for the entire rectangle, much of which may be flat land. Even the extensive upland plateaus of New England do not show up by this method; the plateaus may be perfectly level, but a single deeply incised river may give the rectangle a high index number. Thus we concluded that the method applied by Smith is good only on maturely dissected plateaus of horizontal sedimentary rock structure with uniform slopes and simple physiographic history. In geologically complex regions different methods must be applied.

Of course, it would have been possible to make the rectangles smaller than five minutes. This also was attempted by making the rectangles as small as one square mile. The result was, however, such a complex patchwork of widely different index numbers that no workable map could be prepared on a smaller scale than 1:250,000. This,

of course, would be suitable for state land-planning offices but would be impracticable where a smaller scale is needed.

Next a modification of this plan was attempted. Instead of dividing the topographical sheets into equal five-minute rectangles, they were subdivided into irregular areas showing the same relief, carefully separating the outstanding monadnocks and the deeply incised rivers

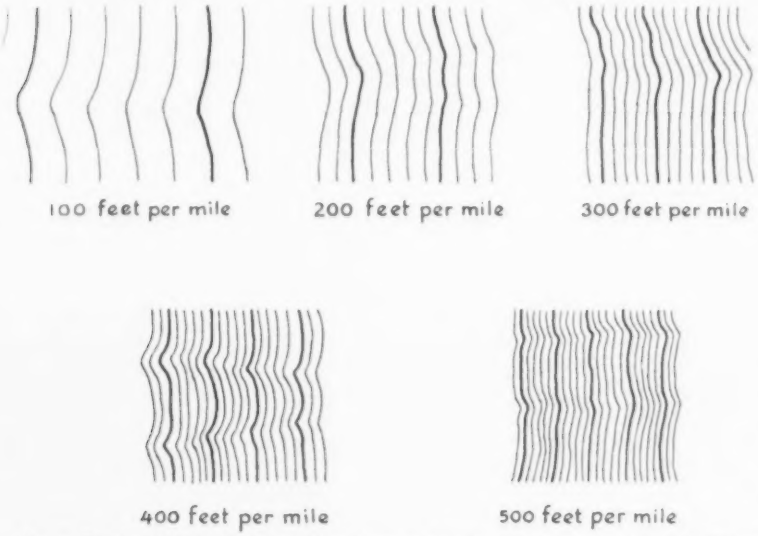


FIG. 2—Density of contour lines at various slopes on a 1 : 625,000 topographic sheet with 20-foot contour intervals. The contour interval for the 50 feet to a mile slopes, which occupy only a small area on the map, is not shown here.

so that the flat lands should not lose their identity. The results obtained were much better than by the rectangle method, but the map was still unsatisfactory. Although the region had been divided into divisions of equal relative relief the area of the regions could not be made even. When the difference between the highest and the lowest point of each area was taken and the places of equal difference connected with isopleths, the resulting map showed so many divergences from actual observation that the map had to be discarded. The reason for this was the inequality of the areas. For instance, Watatic Mountain, which stands out as a dominating monadnock but occupies only two square miles, got a lower index number than the surrounding extensive flat uplands, which in long, gentle slopes attained a greater difference in altitude.

Finally we decided on an entirely unorthodox method, the result of which is the map shown in Figure 3. Each topographic sheet was subdivided, as in the previous method, into smaller regions so that within each subdivision the density of contour lines should be about the

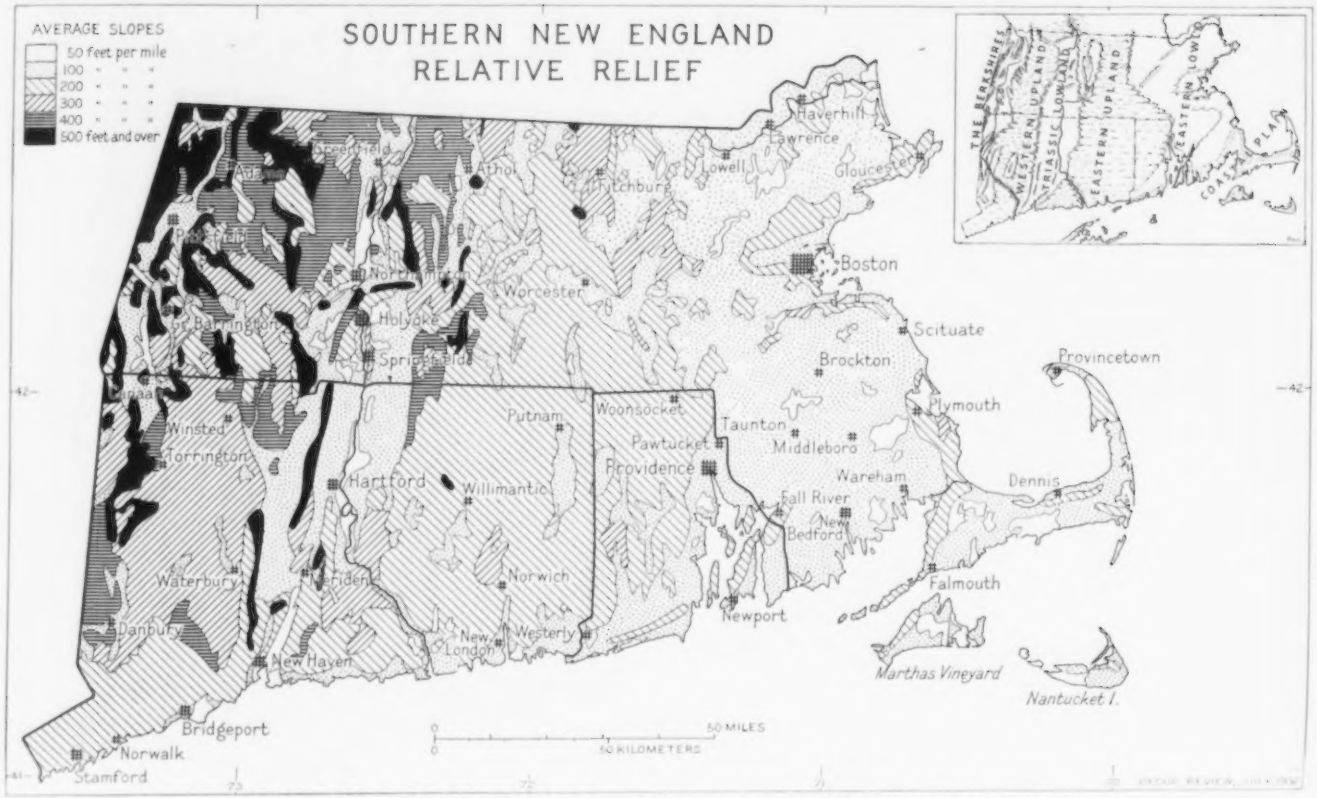


FIG. 4.—An average-slope map of southern New England. Scale 1 : 2,000,000. The inset shows the main physiographic regions.

same. The size of the subdivisions is very different, depending on the evenness of the relief, and their outlines may be quite irregular. It is not advisable to make the subdivisions too small, rarely smaller than a square mile. Occasional small knobs or small incised rivers can be disregarded. Usually there were in southern New England three to ten subdivisions to a topographic sheet. The subdivisions were outlined with colored crayon. It is practical to lay out all the adjacent sheets too, to see the marginal relationships.

Instead of taking the highest and lowest points in each subdivision, as in the previous methods, the subdivisions were classified into six categories according to the average density of the contour lines. A guide to the density of contour lines was prepared for average slopes of 50, 100, 200, 300, 400, and 500 feet to the mile (Fig. 2).

With this guide in hand each subdivision was carefully examined and classified accordingly. The subdivisions were then transferred to a small-scale base map, which has been redrawn into Figure 3. Although in this matter individual judgment seemed to play an important role, there was usually very little doubt in which of the six categories the region should be placed. Of course, there were many border cases, but it was scarcely material whether they were assigned to the upper or the lower classification, and the difficulty could have been avoided by using finer distinctions.

The Resulting Map

The resulting map (Fig. 3) seems to agree well with the field observations. The major physiographic divisions of the land are easily recognized, and none of the major culturally important lowlands are missed. One objection to this method is that it is dependent on the accuracy of mapping. Where the contour lines are more generalized a region will appear to be of a lower relative relief than on a map where the contour line work is better. In all this work we had to make allowance for the more generalized topographic sheets of the earlier surveys in giving them a somewhat higher index number than the density of the contour lines indicated; but as the greater part of southern New England was surveyed at the same time, the results are comparable.

The map of relative relief shows a marked similarity to the map of the physiographic regions of southern New England (inset on Fig. 3), although the latter is based on geological structure and surface types and not on relative relief alone.

The strongly contrasted gradations for the Berkshires in western New England explain the scenic beauty of this region and its growing importance for recreation. The light patches in the western upland mean flat plateaus, whereas in the eastern upland they rather mean

wide valleys. The moraines in the eastern parts and the rugged rim of the Boston basin stand out clearly.

As for possible uses, the regions with an average 100-feet-to-a-mile slope can be cultivated, but they are actually plowed only when soil conditions make it profitable. Regions with 200-feet and 300-feet-to-a-mile slope are cultivated in occasional small patches, but most of the land—if used at all—is used for hay fields. Regions with 400-feet-to-a-mile slope can be used for stony pasture, and the steeper land is left in forest. Of course there are always exceptions. The map is not detailed enough to show every piece of flat cultivable land in the steeper areas, and again some Italian gardeners by means of terracing cultivate unbelievable slopes.

In general, however, the map gives a good picture of the actual use of the land and an even better picture of its possibilities. The preparation of relative relief maps of regions seems to the authors to be indispensable for their geographical study. For the student it helps to clear away misconceptions, so often is elevation above sea level confused with mountainous relief. The method to be used should be carefully considered. In maturely dissected plains and plateaus the method used by Smith will be satisfactory, but in complex regions the method described in the preceding pages is recommended.

STUDIES OF DEPOPULATION IN THE MOUNTAINS OF ITALY

A. R. Toniolo
University of Bologna

IN lands of old civilization and dense settlement the progressive depopulation of mountainous areas, with the abandonment of fields and dwellings, is a well known phenomenon. The trend is particularly marked in the Alps, where scanty economic resources have forced the inhabitants to lead lives of hard labor and penury that are repugnant to the generation of today. Throughout the Alps as a whole, but more particularly in the French Alps, this trend reached a peak in the decade 1881–1890. A period of stagnation followed, but since the World War the movement has been resumed on an even greater scale than before. Only in the Eastern Alps is depopulation progressing slowly and with relatively slight intensity in scattered localities.

In the highlands, which occupy four fifths of the surface of the kingdom of Italy, there are wide zones of demographic decline. Since outlets for expansion into other parts of the world are closed, the mountain population, where the natural rate of increase is high, is becoming ever more densely concentrated on the narrow, relatively level, and already overpopulated tracts that lie within or border on the mountain regions themselves.

The Geographical Committee of the National Research Council of Italy, in coöperation with the National Institute of Agricultural Economics, has initiated a series of regional studies intended to throw light on this movement in its geographical, economic, and social aspects. The field work is being carried out by authorities familiar with the different mountain regions of the country.[1]

The scope of these investigations of "mountain depopulation" (*spopolamento montano*) has been defined as covering not only the larger causes for the decline in population but also "the total or partial abandonment of territory by the inhabitants . . . with the continuous or intermittent shifting of centers of rural life and the deterioration of geographico-economic conditions in the regions under examination."

Indeed, in the Italian Alps there are a good many areas where "depopulation" in the sense of the term just indicated is associated with a static or even an increasing total number of people. This is occurring where the population is moving down from higher to lower levels of ground or else where the exodus of mountain families is counterbalanced by a high birth rate or by immigration into settlements on the valley floors, as a result of causes more or less independent of the environment (such as public works, industries, military enterprises, etc.)

Liguria and Piedmont

Mountain depopulation presents somewhat different aspects in the several mountain regions of Italy so far studied. It is well known that the Alps of Liguria and Piedmont lack a foothill zone whose economic life might serve to supplement that of the high mountains. Here short, steep-walled valleys lead down directly to the plain of the Po; along their courses narrow ravines separate somewhat open basins from one another. The prevalence of crystalline and schistose rocks accounts for vast uncultivated tracts, and what cultivation there is is carried to the extreme

[1] Lo spopolamento montano in Italia, published by the Comitato Nazionale per la Geografia and Istituto Nazionale di Economia Agraria, Rome, 1932–1935. To date monographs have been published on the following regions: the Apennines of Emilia, Tuscany, and Romagna (Vol. 1), the Alps of the Trentino (Vol. 2), and the Alps of Liguria and Piedmont (Vol. 3). Studies of the Alps of Lombardy and of the Venetian and Julian Alps are nearly complete.

limits of the arable land. Flocks of sheep, tended by nomadic shepherds, have done much to deplete the sparse natural pastures. To these restrictive conditions must be added the low birth rate among the mountaineers, which, as in the neighboring French Alps, accounts for a shortage of labor available for tilling of the soil.

For these reasons the problem is more serious in the Alps of Piedmont than in any other mountain region of Italy. Before 1870 depopulation was sporadic and confined almost entirely to the upper Dora Riparia Valley and the Val Pellice. Since then it has become general. The mountain population as a whole (a little more than 500,000) increased slowly until 1901, but today it is steadily declining in numbers, especially to the south—in the Maritime, Cottian, and Graian Alps—and this despite the fact that emigration to foreign countries has practically ceased.

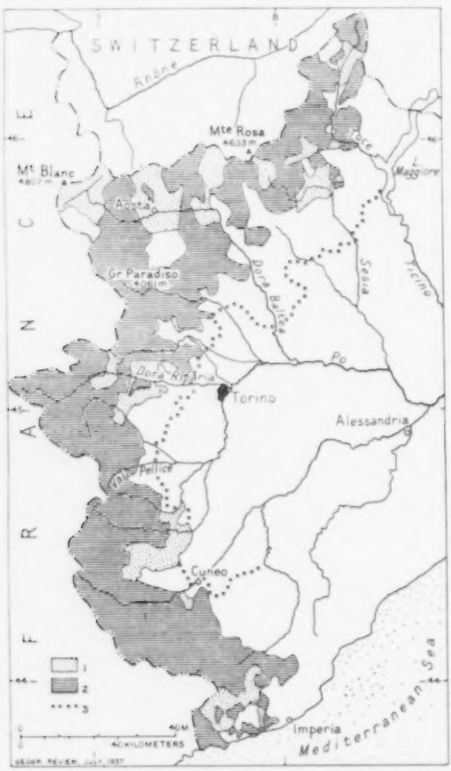


FIG. 1—Depopulation in the Ligurian and Piedmontese Alps. The zone of "mountain depopulation" (see text) is shown by ruling (2); other areas in which population decreased between 1871 and 1921 are shown in stipple (1). The dotted line (3) shows the limit of the zone studied. Scale, 1 : 2,850,000.

In only three zones has there been an increase in population, and the gain here has been slow: along the Riviera near San Remo, where there are exceptionally favorable agricultural conditions and tourist resorts, and in the Ossolane valleys and the middle part of the Val d'Aosta, where there are industries and mines. Everywhere else among the Piedmontese valleys, where an agricultural and pastoral economy prevails, depopulation is in progress. The upper limit of permanent habitation and cultivated fields is moving down the mountain sides; the buildings left behind are falling into ruins; abandoned fields are becoming choked with weeds; and intensive methods of farming are giving place to extensive and irregular practices. These are but outward manifestations of an increasing rate of decline in the birth rate, a flow of population from the high mountains into the centers on the valley floors, and a gradual transformation of mountain families from an agricultural-pastoral into a purely pastoral or purely laboring type.

Among the many circumstances to which students have ascribed the depopulation of the Alps of Piedmont, one seems to dominate and include all the others: the difference between the standards of living that prevail in the mountains and on the neighboring plain. This inequality, of course, has always existed. In the past, however, the mountaineers have hardly been aware of it, isolated as they were in their valleys and economically self-sufficient. Today the breakdown of self-suffi-

ciency, improved communications, and a more active participation in civic life have suddenly made the mountain folk acutely conscious of their relative disadvantages, and they have undergone a severe psychological reaction, despite their strong attachment to the soil and local traditions.

Certain minor factors also have operated with varying intensity in the different valleys, such as deforestation and the closely associated damage done by floods, avalanches, and landslides, particularly in the Val Sesia and the Val d'Aosta; excessive subdivision of landed properties, more especially in the southern part of the region; lack of good roads in the high mountains; the wretched condition of the mountaineers' dwellings, worst of all in the barren Cottian Alps; the heavy burden of communal taxes, notably in the upper pastoral zones; the extreme severity of the forest regulations of today, regulations intended to rectify past mistakes in regard to deforestation and control of runoff (for example, pasturing of sheep, restricted within certain definite limits, is now confined almost exclusively to the high valleys of the Cottian and Graian Alps); and, finally, engineering operations at the headwaters of the principal rivers (Toce, Sesia, Dora Baltea, Dora Riparia, etc.) in connection with the installation of some of the largest hydro-electric stations of Europe—operations that have formed into artificial lakes the floors of many a high cirque formerly used for pasture.

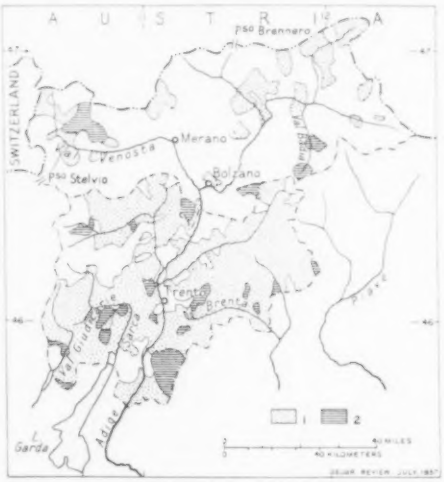


FIG. 2—Depopulation in the Trentine Alps. The zone of "mountain depopulation" (see text) is shown by ruling (2); other areas in which population decreased between 1871 and 1921 are shown in stipple (1).

THE TRENTINE ALPS

The Trentine Alps consist of a zone of high mountains in the heart of the Eastern Alps, where a population of some 660,000 inhabitants has recently been restored to the mother country, and a broad foothill belt separating this zone from the Venetian plain. Included almost wholly within the watershed of the River Adige, the region is subdivided into a complex of ridges, minor valleys, and orographic basins between which communications are not easy. Pleistocene glaciers overdeepened the main valley of the Adige, the only part of the region where large towns exist and where roads and railways form links in one of the main European lines of communication.

In the most northerly province, that of Bolzano near the continental divide, crystalline rocks prevail. The people, German-speaking in the majority, derive their living from a pastoral and forest economy. They occupy large isolated permanent habitations (*masi*) situated on broad orographic terraces amidst extensive woods and rich pastures. The density of population is everywhere low (it averages about 40 to the square kilometer), except in the broad longitudinal valleys, where there are cultivated fields, and in wide basins around Merano and Bolzano, where there are vineyards and orchards. The tourist industry, which has long been well organized, provides an important supplementary source of income. A slight increase in the number of inhabitants from 1870 to 1910 may be ascribed to a constant excess of

births over deaths. Since the World War there has been a pronounced jump in the population, owing to Italian agricultural and industrial settlements on the valley floor of the Adige.

Except as regards a few small areas in the upper Val Venosta and Val Badia, one cannot speak of depopulation in the Province of Bolzano in the sense of the term hitherto used. Good houses, family solidarity, profound religious sentiment, limited emigration, and considerable wealth in the form of livestock and forest property are the circumstances to which the investigators attribute the fact that there has been almost no absolute decline in the population of this province. All of these favorable circumstances, furthermore, appear to be closely connected with a traditional institution among the German population: the *maso chiuso*, or unified farmhold maintained intact from generation to generation and capable of supporting a family group of from five to twenty persons.

Indications are not wanting, however, that an economic crisis is being reached in the matter of livestock and woodlots and that this crisis may lead to overpopulation—often the precursor of depopulation in the strict sense of the term.

The Province of Trent, which comprises the Dolomites and the calcareous zone of prealps to the south, is inhabited by Italians (mean density 59 to the square kilometer). Here conditions are not generally favorable for rural settlement, owing to the small amount of arable land and extensive tracts of bare rock or rocky pasture. Areas capable of exploitation are restricted to porphyritic tablelands and certain high basins at the foot of dolomitic crags, where silvi-pastoral communities form small isolated groups out of touch with the centers of population and culture in the overdeepened valleys of the Adige, Brenta, and Sarca. The calcareous prealpine zone, which extends east to the karst plateaus, is a country of poor pastures and scattered woods, with much unproductive ground.

In the Province of Trent a high birth rate was accompanied after 1890 by a strong current of emigration overseas and a declining population. The decline has continued even more rapidly since the World War in spite of the fact that emigration to foreign countries has ceased. Up to the present, depopulation has not produced any very notable changes except in the poorest parts of the Valle Giudicarie and on the eastern prealpine plateaus, which were devastated during the War. There are many signs, however, that a sudden rapid exodus is likely to begin in the near future —particularly in the southern part of the province, where a highly irrational polyculture has been carried to extremes and conditions of life are growing considerably worse. The exodus, when it comes, will be due primarily to the excessive subdivision of landed property (the *maso chiuso* does not prevail among the Italians), the cutting off of emigration to America and Central Europe, heavy communal taxes, and the recent agricultural crisis, with the mounting burdens of debt that it has placed on the farmers.

Emilia, Tuscany, and the Romagna

In the Apennines of the Emilia, Tuscany, and the Romagna mountain depopulation appears to be taking a course similar to that followed in the Piedmontese Alps, although as yet it has not become alarming.

An important physiographic feature of this part of the Apennines is a central backbone of hard sandstones at an average elevation of about 2000 meters. In this many small valleys have been eroded, and the interfluves are covered with natural pastures, cropped in summer by sheep driven up from winter quarters on the plain of the Po or the Tuscan Maremma. Below the backbone at an altitude of about 1000 meters there are formations of marl (*molasse*) and scaly clays (*argille scagliose*).[2]

[2] "Very muddy after rains these clays in summer split up into scales, the color of which varies from blue gray to yellow, and in some places rose or green" (Jules Sion: Méditerranée: péninsules méditerranéenes, *Géographie Universelle, Vol. 7*, Paris, 1934, p. 296).—Edit. Note.

in which, on the Adriatic slope the watercourses have incised narrow gorges. This is a region of beech forests, where charcoal burning is the principal industry. On the Tuscan side the slopes of wide longitudinal valleys are clothed with chestnut woods. Both the beech trees and the chestnuts furnish important sources of income for the mountaineers, who are accustomed to migrate seasonally to the neighboring plains either as shepherds, laborers, or vendors of charcoal.

On the Adriatic slope below the 1000-meter level, there extends a hill country where Miocene and Pliocene clays and sands predominate. Here the wide valley floors of the consequent streams are filled with detritus, and the original valley walls have been badly gullied as a result of deforestation in ancient times. A poor type of cultivation, which has replaced the natural scrub vegetation, yields only scant returns, owing to the excessive subdivision of the landholdings. While this is particularly true of the Apennines of the Romagna, share farming (*mezzandria*) is widespread in the subalpine zone and on the Tuscan slope. In the northern Apennines generally the industries characteristic of the Alps are lacking, industries such as logging and woodworking, which might serve to supplement the scanty livelihoods to be derived from a mountain economy of the kind described.

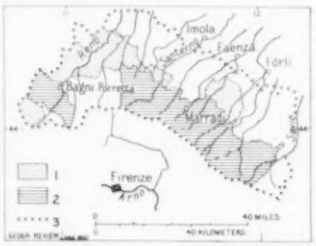


FIG. 3—Depopulation in the Apennines of Emilia, Tuscany, and the Romagna. The zone of "mountain depopulation" (see text) is shown by ruling (2); other areas in which population decreased between 1871 and 1921 are shown in stipple (1). The dotted line (3) shows the limit of the zone studied.

The population of the territory investigated—which is included in the provinces of Bologna, Forlì, Ravenna, Pistoia, and Florence—is about 24,000 but with rather high densities (average: 60 to the square kilometer). Although the total number of people increased considerably between 1870 and 1921, this period of growth has been followed by a pronounced decrease during the last decade, due in part to abandonment and in part to a decline in the natural increment. Hence true phenomena of mountain depopulation are evident, although they have not advanced as yet beyond initial stages and are confined to the higher altitudes. Depopulation, however, seems destined to continue and increase. Cases are frequent of entire families' moving down from the mountains into the hills, there to remain for a while before continuing descent to the plains.

As in the Alps of Piedmont, the fundamental causes for the changes are partly economic and partly psychological and are associated with the contrast between the diversified and progressive agriculture of the lowlands and the backward rural life of the mountains. Much local labor from the mountain region was employed on the construction of the railway and its many tunnels (completed in 1928) that provide a direct connection between Bologna and Florence. Since then those who were engaged in this great undertaking have not been able to readapt themselves to the harsh life of the highlands, where almost the sole important source of revenue, the pasturing of flocks, is today closely restricted by necessary rules and regulations intended in some degree to remedy the evils due to thoughtless deforestation in past times. As long as no outlet is opened for emigration to foreign lands, it may be foreseen that the descent of the mountaineers to the hills and plains will continue with ever-increasing momentum.

These conclusions, based upon the first detailed studies of mountain depopulation in Italy, fit into a larger picture: that of the overcrowding of the Italian people within their own country, for which no radical internal remedies can ever be fully effective—neither the colossal works of reclamation now being carried out nor the internal migrations that appear to be producing such impressive results.

ROCK SCULPTURE BY GLACIERS: A REVIEW*

O. D. von Engeln
Cornell University

IN a region subjected to efficacious transgression by glaciers ice sculpture is dominant to the degree that it transcends rock structure. Hence, in general, all glacially modeled landscapes develop a uniform aspect and the same particular geomorphological forms. This is the novel doctrine advanced by Otto Flückiger, who also provides a new concept of glacial motion.

Roches Moutonnées

Flückiger holds that the presence of roches moutonnées is the universal earmark of the invasion of an area by glacial ice. The orthodox view is that they are (1) an indication of the superior resistance to glacial erosion of the rock masses comprising the knobs; (2) marks of incomplete glacial sculpture; and, (3) in form, a reflection of particular characteristics of rock structure and of two unlike processes of glacial erosion.

In Flückiger's view these ideas are the products of reasoning in a circle—the rock is resistant because it is a roche moutonnée; roches moutonnées are present hence the rocks must be hard. It is also implied that the roches moutonnées are the remainder of a preglacial rock relief. Flückiger asserts that where ice action has been most vigorous and enduring roches moutonnées are found to be most prominently developed. Matthes[1] maintains that the roches moutonnées result from the presence and spacing of joint fissures. In epitome, this is the concept that Flückiger would discard. The writer questioned[2] Matthes' contention that roches moutonnées require the presence of obdurate bosses of rock and published a photograph showing a roche moutonnée abundantly jointed over the whole length of the stoss side. As this example was affected by quarrying on the stoss side it would seem to refute Matthes' concept of a completely obdurate core.

At the crest of the lee declivity tension is introduced, and the melting point of the ice is raised. The interior of a glacier is at the pressure-temperature melting point. A sudden diminution of pressure should result in a firming of the ice and its freezing adherence to the rock. Such adhesion is equal to or greater than the cohesion of ice. Where clear ice is in direct contact with the bedrock the measure of the adherence must be at least that of the tensional strength of ice, which is about seven tons to the square foot. A quarrying force of such dimensions would produce the steep, hackled effect characteristic of the lee sides of roches moutonnées.

Flückiger recognizes the asymmetrical form of roches moutonnées. The difference in aspect results, he says (p. 21), because the stoss side is subjected to strong pressure and active abrasion by the ice as long as the glacier is in full flow across the area; whereas in the declining phases of the glacier the ice on the lee side loses so much plasticity that it no longer maintains intimate contact with the rock. There may even be an open space in which frost weathering can occur. In flood stages the ice

*Otto Flückiger: Glaziale Felsformen, *Petermanns Mitt. Ergänzungsheft No. 218*, 1934.

Flückiger's paper is of such length and merit as to warrant book publication. The reviewer here presents Flückiger's ideas on the origin of two especially prominent items in glaciated landscapes and the evidence he cites in support of his interpretations, together with such supplemental material, illustrations, and comments as seem pertinent. It is planned to treat further aspects and topics of Flückiger's work elsewhere.

[1] F. E. Matthes: Geologic History of the Yosemite Valley, *U. S. Geol. Survey Professional Paper 160*, 1930, pp. 95–96.

[2] O. D. von Engeln: Palisade Glacier of the High Sierra of California, *Bull. Geol. Soc. of America* Vol. 44, 1933, pp. 575–599; reference on pp. 586 (Fig. 9) and 592.

will be pressed closely against the lee side and abrade this smoothly to match the stoss side.

Forms of the roches moutonnées vary. Where ice motion was parallel to the strike of steeply dipping, bedded rocks elongate ridges consisting of the more resistant formations appear. The area at the front of the Aletsch Glacier is cited among other examples (p. 8). If, contrariwise, the strike is at right angles to the direction of ice flow the roches moutonnées appear as low, shieldlike mounds. On these mounds the ice, however, exercises a secondary, differential erosion in the direction of the strike, so that a surficial ornamentation of low ribs and hollows appears. All variations of form are possible to roches moutonnées, from woolsack and half cylindrical swellings, to round, balloon-like knobs.

Roches moutonnées landscapes have a wide distribution—a fact not fully realized because of failure to appreciate how greatly their order of magnitude varies. The observer in the Alps visualizes as roche moutonnée fields the small-scale developments of such transfluence (pass) sites as the Gotthard and Simplon. But off Bergen, Norway, the dimensions of the roches moutonnées are by comparison heroic.

If roches moutonnées are attributed to "hardness" differences in the glacier bed why are they always distributed in pattern-like regularity? At sites where the rock structure is banded, for example the Gemmi Pass, glacially eroded ridges and furrows occur. But at these places the roches moutonnées are disposed in the flow direction, obliquely across such ridges and hollows. Hence if the ridges and furrows are, properly, ascribed to differences in durability, it would seem unwarranted to consider the roches moutonnées a dot pattern, *likewise due to hardness differences*, superposed on the band pattern. If joint and other cleavages are responsible, then the preglacial cleavage pattern must always have been in accordance with the flow direction of the ice—a manifest absurdity.

Other authors, notably Davis, regard roches moutonnées as residuals of a preglacial topography not completely reduced by ice action. A restoration would require a fantastic jaggedness in the preglacial landscape. On this assumption if there were long enough application of glacial action the preglacial irregularities would be completely eliminated. Then at sites where the ice has had an unquestioned existence for a longer than average time, for example at the borders of the Greenland ice sheet, roches moutonnées should have been eliminated. Instead, roches moutonnées there attain especial prominence. So also in the Alps, roches moutonnées attain far greater expression toward the heads of glacier-occupied valleys than in their lower sections, as is clear from the numerous examples cited by Flückiger (p. 17).

Transfluence sites in the Alps show that roches moutonnées floors exist where deep erosion of a preglacial rock surface is implied. The St. Gotthard Pass is an outstanding example. By comparison with the Lucendro Pass, opened by cirque intersection, several hundred meters of lowering of the St. Gotthard Pass by glacial erosion is, however, a warranted deduction. But, if the St. Gotthard Pass was so deeply ice-eroded, it would be preposterous to regard the roches moutonnées knobs on its floor as remainders of, or inheritances from, the angularities of the rock relief of the original breach. It is equally unwarranted to assume that the roches moutonnées are present because glacial erosion was incompetent to reduce the original level significantly.

Flückiger cites numerous instances from different localities in support of his contention that the roche moutonnée form is the universal end product of glacial erosion. Figure 1, from Turnavik Island, Labrador, shows a severely glaciated area, but there does not seem to be any relation between the development of the roches moutonnées and the pattern of the joints. Glacial processing has converted the plateau hills of central New York to a vast sea of roches moutonnées—a topographic effect that is strikingly evident when the region is seen from the air. These roches moutonnées, however, are commonly steeper on the stoss side. The dip of the New

York State plateau formations is to the south. According to Flückiger (see reference to Altels Glacier below), where a glacier moves down the dip over stratification plane surfaces it is little, if at all, effective as an eroding agent. As the ice here advanced from the north, the reversal in steepness of slopes is appropriate. Shaler and Davis were evidently aware of this principle as early as 1881.[3]

Glaciers, Flückiger contends (pp. 18–19), are supported in their descents over terminal icefalls (Rhone glacier) by roches moutonnées developed to a stepped form.

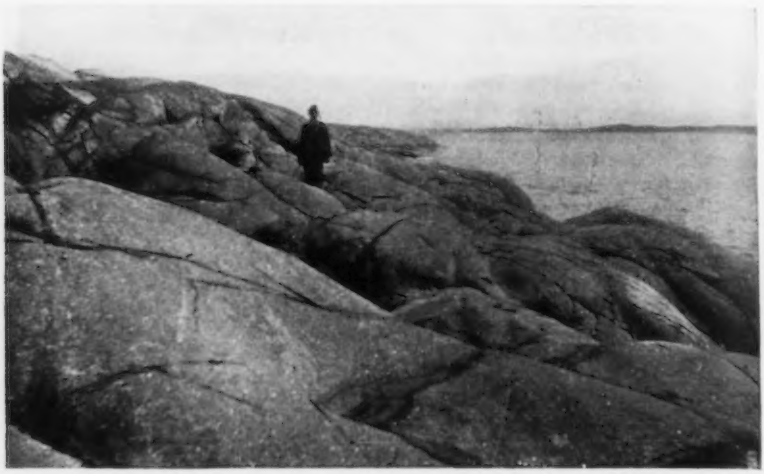


FIG. 1—Roche moutonnée surface, Turnavik Island (Battle Harbor), Labrador. The rock is massive, and there is no discernible relationship between the glacial modeling and the pattern of the jointing. (Photograph by R. S. Tarr.)

The available evidence, he holds, all indicates that the interior ice flow of glaciers is plastic (p. 20). At its sole the glacier may be conceived of as feeling its way from step to step down the fall. In the upper thicknesses the internal movement of the ice is easier and more rapid. But the internal "viscosity" is sufficiently high to prevent a parting between the upper ice and the debris-laden lower layers. In consequence of such relation the ice advance consists of a series of *great waves*.

This concept is defended at length (p. 25) by appeal to the physical principle that where two gases or fluids of different specific gravity move past each other at unlike speeds undulatory waves will develop at the surface of contact. This principle also applies to the contact plane between two solids. The "washboard" surface developed on highways subjected to fast and dense automobile traffic is probably a manifestation of this effect. With regard to ice and glaciers the phenomenon has been discussed at length by Ljungner[4] in a paper that does not seem to have been noticed by Flückiger. Ljungner does not, however, conceive that an induced wave motion affects the whole thickness of the ice stream. Flückiger considers such undulation to be the chief characteristic of glacier motion.

Roches moutonnées are the mold of the standing waves of the ice stream. The fashioning and progressive enlargement of such irregularities on the rock floor enables the ice to flow over steep slopes. One exception is noted. In the Altels Glacier of

[3] N. S. Shaler and W. M. Davis: Illustrations of the Earth's Surface: Glaciers, Boston, 1881. Fig. 12, p. 56.

[4] Erik Ljungner: Spaltentektonik und Morphologie der schwedischen Skagerrak-Küste. *Bull. Geol. Instn. Univ. of Upsala*, Vol. 21, 1930, pp. 330 and 343.

the Bernese Oberland there was an ice avalanche in September, 1895. A part of the hanging glacier slid down a stratification plane inclined 30°. This rock surface, which is again exposed by the retreat of the glacier in recent years, shows only faint development of roche moutonnée forms.

Flückiger also finds the origin of drumlins in the wave flow of the ice. He asserts that under the terminal parts of glaciers, overburdened with ground moraine, the wave crests and troughs model the debris to drumlin forms. In support of such

FIG. 2—An "ice wave" moving from left to right over a roche moutonnée. Note the burden of ground moraine. The figure seen dimly on the left gives the scale. Margin of the Cornell Glacier, Greenland, 1896. (Photograph by R. S. Tarr. Interpretation authenticated by Jay A. Bonsteel.)

correlation Flückiger describes an extraordinary development of roches moutonnées in unconsolidated materials. A landslide mass on the floor of the Bedretto Valley, Switzerland, was overridden by an advance of a glacier from the head of the valley, as is indicated by the presence of erratics and morainic debris on the surface. This deposit as a whole was reshaped by the glacier into a characteristic roche moutonnée field. The knobs are oriented in the direction of ice motion; they are elongated where the landslide blocks were on edge and parallel to the glacier axis; they are rounded where the blocks were irregularly disposed; and they exhibit characteristic stoss and lee sides, well preserved despite postglacial weathering and wash.

Flückiger pursues the argument that roches moutonnées are new forms, originating through glacial sculpture, by reference to the skerry islands off the Norwegian coast. These he interprets as remnants of a former level platform of marine abrasion. Recent geomorphological studies, however, incline to the idea that this is a peneplaned region. The southern Åland Islands area and the skerry islands off the Baltic coast of Finland, another peneplaned region, which the writer has had opportunity to observe, are an extraordinarily complete and perfect roche moutonnée field. But it is Flückiger's idea that these roches moutonnées are evidence of the manufacture *de novo* of that form from a plane rock surface, developed as a marine abrasion platform. Over a peneplaned surface the preglacial relief, in detail, would measure many feet and, in crystalline rock, would have a knobby aspect. Great reduction in level may have resulted from glacial erosion. But the assumption that glacial erosion was here initiated on a perfectly plane and fresh rock surface where structures of varying resistance outcropped is not warranted.

Rock Bastions

The term bastion is used by Flückiger in the course of his discussion, but his preferred word is *Felsvorbau* which, literally translated, is rock screen. He conceives that where tributary glaciers joined main glaciers the outlets of the hanging valleys are fronted by rock masses that project far out into the main valley. Such projection, when ideally and prominently developed, may best be compared to the conventional

FIG. 3—Rock bastion of the Cascading Glacier, Yakutat Bay, Alaska. The stair-step pattern, which Fluckiger postulates for such sites, is here clearly in evidence. (Photograph by R. S. Tarr.)

theatrical stage with its curved front and its flat floor raised high above the audience level. Flückiger's recognition of these forms as a distinctive phenomenon may be regarded as a noteworthy contribution to geomorphology.

It is his contention that the development of such "rock screens" is indicative of the ability of the tributary glacier to impede and deflect the flow of the main glacier at the point of confluence. Evidence of such deflection is seen in the exceptionally vigorous lateral erosion by the trunk glacier of the wall of the main valley opposite the junction. Of the reality of the phenomenon there can be no question. Besides the numerous examples Flückiger cites from the Alps, such forms are prominently developed in Alaska (Fig. 3). Flückiger makes clear that the perfect stage or bastion form is only exceptionally developed. He describes many and varied examples as a basis for his argument that the phenomenon is not conditioned by structure.

It is interesting to note that the rock bastion phenomenon was not developed in the glaciated Finger Lakes region of central New York where hanging valleys are a prominent feature. In this case the glacial currents were divergent, instead of convergent. Accordingly the lips of the hanging valleys tended to be flush with or recessed into the main valley side instead of being developed to projections. On the other hand the swinging flow of bottom currents in the ice of the Finger Lakes region left its impress of differential lateral erosion on the channels, through valleys, of the plateau country, such as Texas Hollow, aligned with the axes of the ice advance. The reviewer believes that further field study of the phenomenon will be profitable.

AMERICAN GEOGRAPHICAL SOCIETY

The **March Meeting.** The regular monthly meeting of the American Geographical Society was held on March 23, 1937, at the Engineering Societies' Building, 29 West 39th Street, Mr. Henry presiding. Mr. Richard Finnie delivered a lecture entitled "A Year among the 'Blond' Eskimos." Mr. Finnie was born at Dawson, Yukon Territory, and has traveled widely in the Canadian Arctic. In 1930 and 1931, as special investigator for the Canadian government, he spent a year with the Copper Eskimos of Coronation Gulf, the so-called "Blond Eskimos." In his lecture, which was illustrated with motion pictures, he gave an intimate account of the life and customs of this most primitive of Eskimo tribes.

The **April Meeting.** The regular monthly meeting of the Society was held on April 20, 1937, at the Engineering Societies' Building, 29 West 39th Street, Mr. Platt, Secretary of the Society, presiding. Mr. Julien Bryan delivered a lecture entitled "Turkey Reborn." Mr. Bryan has been successful in bringing to the American lecture platform a remarkable series of motion-picture records of recent social and economic developments in several countries generally considered closed to the motion-picture reporter. His pictures of Turkey are the most recent of a series including the U.S.S.R., Japan, Manchukuo, and Poland. His lecture dealt with Turkey's endeavors toward modernization and national self-sufficiency.

The Frame of the Ancient Greek Maps. The Society has just published a volume by Professor William Arthur Heidel of Wesleyan University entitled "The Frame of the Ancient Greek Maps: With a Discussion of the Discovery of the Sphericity of the Earth" (*Amer. Geogr. Soc. Research Ser. No. 20*).

The foundations of geography as we know it today were laid by the Greeks. They were the first to attempt the construction of world maps on the basis of astronomical observations and the measurement of terrestrial distances. At first by suggesting, as a purely theoretical hypothesis, that the earth is a sphere, and later by not only stating proofs of its sphericity but actually calculating its circumference, they made a truly glorious contribution to human enlightenment. Dr. Heidel deals with these two aspects of the history of Greek geography.

No actual copies of Greek maps dating from the period before Christ have been preserved, but from scattered fragmentary references in the writings of classical and medieval authors it is possible to arrive at some idea of what these maps were like. Through a lifetime of research in the fields of Greek philosophy and science Professor Heidel has acquired a familiarity with these sources that is probably unrivaled in this country. The present study has occupied his attention for twenty years or more. His main purpose is to trace the history of the "frame," or skeleton, of the Greek maps from its beginnings among the Ionians until the time of Eratosthenes, in the second century before Christ. His conclusions are based entirely on examination of the original sources. New points of view are set forth, and not a few opinions that have been widely held by contemporary scholars are shown to be misconceptions. In his explanation of the Ionian tropics, which formed parts of the outer frame of the Greek maps, Professor Heidel introduces a novel concept of importance. Although the discovery of the sphericity of the earth has been frequently attributed to Parmenides, Pythagoras, and other early thinkers, a close analysis of the evidence leads Professor Heidel to the conclusion that this revolutionary theory could not have been propounded until the time of Socrates.

The book shows that the cartographic tradition of the ancient Greeks displayed a marked degree of continuity—a conservatism that nevertheless permitted ample scope for innovation and development to the individual thinker. This same con-

tinuity Professor Heidel has found to characterize other special traditions in the field of Greek thought. His study thus bears directly on a larger theme than geography alone and is of interest for the insight that it gives us into the quality and functioning of the ancient Greek mind.

The Millionth Map of Hispanic America. Since the first of the year 14 new sheets of the Map of Hispanic America on the scale of 1 : 1,000,000 have been published, bringing the total of published sheets to 77. The new sheets consist of three in Mexico (Sonora, North H-12; Monterrey, North G-14; Istmo de Tehuantepec, North E-15), two in Central America (Lago Nicaragua, North C-16; Tegucigalpa, North D-16), four in Peru (Piura, South B-17; Loreto, South B-18; Trujillo, South C-17; Cerro de Pasco, South C-18), four in Brazil (Fortaleza, South A-24; Bahia, South D-24; Curityba, South G-22; Porto Alegre, South H-22), and one Argentine-Chilean sheet (Santiago-Mendoza, South I-19).

Obituary

Madison Grant. Madison Grant, a councilor of the American Geographical Society from 1913 through 1934, died at his home in New York City on May 30, in his 71st year. Mr. Grant is known to geographers chiefly by his books "The Passing of the Great Race" (1916 and 1918) and "The Conquest of a Continent" (1933). The former has for its central theme "the Nordic race—its origin, its distribution in late geologic and in historic times, its inherent and stable, in a word, its racial qualities, particularly those which have made it great (Mr. Grant would say 'greatest'). . . . . In geographic science the book is important because it will stimulate anew the question of the relative parts which heredity and environment play in human development" (review in *Geogr. Rev.*, Vol. 2, 1916, pp. 477–478). A feature of the book, the maps that ingeniously essayed to portray racial migrations, appeared in the November, 1916, number of the *Geographical Review* (see comments in *Geogr. Journ.*, Vol. 49, 1917, pp. 233–234; also Vol. 50, 1917, pp. 222–224). The provocative value of "The Conquest of a Continent," which has for its subtitle "The Expansion of Races in America," is stressed by Dr. H. J. Fleure in his review: "One can but hope that Madison Grant's book may create demand for a more balanced study of the factors of development and maintenance of civilization in North America" (*Geogr. Journ.*, Vol. 84, 1934, p. 87).

Mr. Grant's prime scientific interest, however, was zoölogical. He shared in the founding of the New York Zoological Society and served successively as its secretary and president and as scientific and executive head of its zoölogical park (Bronx Park) and aquarium (Battery Park). His reports to that society included "The Caribou" (1902), "The Origin and Relationship of the Large Mammals of North America" (1904), "The Rocky Mountain Goat" (1905). This interest led to his participation in such conservation movements as the work of the American Bison Society and the "Save the Redwoods League." Grateful recognition must be made of his part, as president of the Bronx Parkway Commission for 1907 to 1925, in the creation of the parkways system of Greater New York, described by an English geographer as "an unrivalled series . . . which may well be a nation's pride."

GEOGRAPHICAL RECORD

NORTH AMERICA

The St. Clair Delta. The Great Lakes region is in many ways a unique field for the student of human and economic geography. Actually, however, the total of what has been written about it from the geographical point of view is scant as compared with the wealth and variety of the material that it has to offer.

Of particular interest as regards human occupation is the delta of the St. Clair River, whose hundred square miles are divided between the Canadian province of Ontario and the state of Michigan by the so-called South Channel, the main route through it for deep-draft lake steamships. In the 40 square miles of the American side of the delta summer resorting has long been the chief industry, though the automobile has dealt a severe blow to the great hotels and clubhouses accessible only by water. On the fertile soils of the larger islands there are prosperous farms, among the names of whose present owners are still to be found those of United Empire Loyalists from the East who settled there during and immediately after the American Revolution. In the remote parts of the American section, on the smaller islands and on house sites built up by sheet piling and dredging, are still to be found descendants of the early French settlers, many of them engaged in the pursuits of their forefathers—fishing and hunting—as their chief means of livelihood.

The larger part of the Canadian side of the delta is occupied by the Walpole Reservation, created in 1831 (see Bert Hudgins: The Walpole Indian, *Trans. Royal Soc. of Canada*, Ser. 3, Vol. 30, 1936, Sect. 2, pp. 79-88). The reservation consists of some 40,480 acres, of which only about 12,000, however, are habitable, and is occupied by about 1000 Indians, three-fourths of whom are Chippewa and the rest Potawatomi. The reservation is a remarkable case of an isolated, backward, agricultural people's occupation of fertile soil of high productive possibilities within full view and shouting distance of a resort area of high consumptive potentialities for farm and garden products. The chief reason for its isolation is the fact that it is an Indian reservation; but important also is the fact that the only near-by market for its products lies across a wide, unbridged channel and an international boundary.

Thermal Conditions in Monterey Bay. The Monterey Bay region of California is one of the important fishery centers of the United States. A knowledge of the oceanographic conditions in this region is therefore of considerable practical importance. In 1928 the California Department of Natural Resources and the Hopkins Marine Station of Stanford University entered into a coöperative agreement for a hydrobiological survey of Monterey Bay and vicinity, and in an article of about 150 pages entitled "Hydrography of Monterey Bay, California: Thermal Conditions, 1929–1933" (*Trans. Amer. Philosophical Soc.*, Vol. 29 (N.S.), 1936) Tage Skogsberg presents the detailed results of a study of systematic temperature observations carried out during the five-year period ending in 1933. This study is of more than local interest; for, although Monterey Bay itself is but a comparatively shallow indentation of the coast, its wide opening of some twenty miles and its direct slope into the depths of the open sea make it reflect, more or less closely, changes in the oceanographic conditions of the open sea.

The waters of Monterey Bay are characterized by remarkable stability so far as range of temperature is concerned. Even at the surface the difference between the average temperatures of the coldest and warmest months is less than 3° C. But as regards frequency of thermal changes, the waters are in a state of constant flux; and although much of this fluctuation is irregular, there is a distinct annual rhythm, the amplitude decreasing more or less regularly with depth. This phenomenon, which is of general occurrence, shows here one striking feature: at the surface the

temperature follows the normal pattern of highest values in summer and lowest values in winter; but in the subsurface waters, especially between the 50 and 100-meter depths, the highest temperatures occur in the winter and the lowest temperatures in the summer. Skogsberg finds the annual change in temperature to be characterized by three distinct phases: (*a*) a cold-water phase extending from the middle of February to the end of November for the waters in the upper 100 meters; (*b*) a warm-water phase extending from August through October for the waters in the upper 25 to 50 meters; (*c*) a low thermal-gradient phase with relatively high temperatures for the waters from 50 to 100 meters from December to February.

Obviously the thermal conditions in the subsurface waters of Monterey Bay are due to water movements from the open sea. A study based on current observations and on the relation of the times of the temperature observations to the times of the tide shows that the tidal movement can play but a minor role in the thermal changes in the bay. From the observations to date Skogsberg concludes that the cold-water phase is caused by upwelling, the warm-water phase by the nearer approach of the California Current, and the low thermal-gradient phase by the Davidson Current, which arises from the southerly winds prevailing during the winter months.

H. A. MARMER

Recent Recession of Mendenhall Glacier, Alaska. Published comparisons of the ice-front movements of Alaskan glaciers over comparatively short periods of time have been all too infrequent. Changes of drainage and the minutiae of ice fluctuations are unknown, though larger fluctuations over long periods have been studied and numerous reports have appeared.

The recent recession of the Mendenhall Glacier, northwest of Juneau, is shown in the accompanying figures. Figure 1, obtained through the kindness of Mr. H. G. Peacock of Fairbanks and Mr. E. P. Pond of Juneau, photographer, was taken on August 22, 1936; Figure 2 was taken by the writer on June 24, 1931 (see C. K. Wentworth and L. L. Ray: Studies of Certain Alaskan Glaciers in 1931, *Bull. Geol. Soc. of America*, Vol. 47, 1936, pp. 879–933).

The same portion of the ice front is shown, though the 1936 photograph was taken from a point lower on the valley wall. A study of the two pictures shows that in the five-year interval there has been a retreat of possibly 200 feet along the medial part of the glacier, visible in the mid-ground of the figures. The retreat of the ice along the south margin of the glacier, in the foreground of Figure 2, has been possibly as much as 300 to 400 feet. This greater retreat would normally be expected because of the presence of the lateral-drainage stream. Further comparison shows that there has been a shift in the drainage along the ice front. A part of the lateral-drainage stream, which is the head of Mendenhall River, now passes around the more exposed roche moutonnée and flows for a short distance westward along the ice margin, where it enters the series of ice-front lakes that have by now been much expanded. No evidence of advance may be seen, only a slow melting of the ice mass *in situ*.

Mr. Pond reports that in the summer of 1934 the ice of the tidal Taku Glacier, south of Juneau, at the head of Taku Inlet, had advanced materially beyond the 1931 position. Unfortunately no definite information could be obtained as to the 1936 position of the ice front, to ascertain whether the interesting advance noted in 1931 still continued.

LOUIS L. RAY

The German Element in the Population of the United States. In the sense in which a French statesman once said, "The only French colony is Quebec, and it is not ours," the Germans might well say: "Our greatest colony is in the United States, but it not only is not ours but for the most part is no longer even German." In num-

FIG. 1

FIG. 2

FIG. 1—Mendenhall Glacier ice front, August 22, 1936. (Photograph by E. P. Pond.) (A) marks the approximate position of the ice front in 1916; (B) the Glacier Highway bridge over the Mendenhall River. Low moraine in front of the ice marks the position of about 1909.

FIG. 2—Mendenhall Glacier ice front, June 24, 1931, showing the same portion of the ice front, taken from higher on the valley wall than Figure 1. (Previously reproduced in the *Bulletin of the Geological Society of America.*)

bers the German loss is by far the greater: it is estimated that the population in the United States of direct German descent numbers at least 21 million people, twice the population of Canada. Along with most Germans, Max Hannemann, in "Das Deutschtum in den Vereinigten Staaten· Seine Verbreitung und Entwicklung seit der Mitte des 19. Jahrhunderts" (*Petermanns Mitt. Ergänzungsheft No. 224*, 1936), regrets that most of the descendants of German immigrants into the United States should have given up their German language and culture. He states that there were only eight million German-speaking people in this country in 1920, implying that German was the principal language of all these, though three-fourths of them were born in this country.

The principal part of the study is developed from a series of excellent maps of the German population in this country, based on United States census data. The eight main dot maps show the distribution, on a county basis, of the German-born population for each of the decades from 1860 to 1930. These maps give a clearer picture of the settlement areas of German immigration than has hitherto been available. They amply support the author's conclusion that there has been a marked constancy in the areas of German settlement. New immigrants have gone chiefly to the areas in which their predecessors had settled before 1860. The only notable changes have been in the frontier areas opened for settlement since 1860, chiefly west of the upper Mississippi, in the upper Lake States north of a line through the Twin Cities to central Michigan, throughout the Great Plains and the intermontane regions, and in the Pacific Coast lowlands.

Throughout the period German settlers have been strikingly few in the South, except for a concentration at New Orleans (larger than at Boston) and a scattered group in southern Texas. The Germans' avoidance of this region the author ascribes to its climate and to the slave system and the resultant social attitude of the white population. That the climate was of but slight importance, however, is indicated not merely by the presence of many Germans in New Orleans—not to mention smaller numbers in most Southern cities—but also by the concentrated German settlements in the Ohio Valley as far south as Louisville and Evansville. (He correctly points out that the limit was fixed not along the Ohio River itself but on the south margin of its immediate valley.) To the reviewer it seems likelier that the economic system of the South precluded any large immigration whether from northern or southern Europe. The semiplantation system of the Cotton Belt offered no opportunity to immigrants who came with no capital other than their own strength and skill, and the later industrial development had no need to look outside the region for cheap white labor. Actually one of the few instances of European immigration into the South in the past century was a German group, organized by the Mainzer Adelsverein (organization of nobles), which settled in southern Texas early in the century and has since attracted many other Germans.

Even as early as 1870 most of the German immigrants settled in cities rather than on the land, though the opposite was true west of Chicago. Throughout the period the largest single group was to be found, not in Milwaukee, but in New York. In 1860 Cincinnati and St. Louis had the largest numbers in the Middle West but were exceeded in 1880 by Chicago. Chicago has retained its relative importance in spite of a great increase in Milwaukee, which exceeded St. Louis and Philadelphia first in 1910. A study of the internal migration, based in part on Thornthwaite's work, indicates that during 1920–1930 there was considerable shifting of German immigrants from rural areas and small towns to a few large cities, notably New York, Chicago, and Los Angeles, and also to rural New Jersey. On the basis of rather complicated calculations and certain broad assumptions the author believes that the native born of German parentage have shifted less in the United States than the average of the population and ascribes this to the greater stability of people of German descent.

In his maps the author has worked out an interesting device for showing a small number of large centers without obscuring the scattered dots in the surrounding region. A small open circle is placed at the location of the city, of such diameter as though it were a sphere, and on the margin of the map is placed the full solid circle.

RICHARD HARTSHORNE

A Research Program in the Soil Conservation Service. An editorial note in the April number of *Soil Conservation*, the official organ of the Soil Conservation Service, states: "This issue of the magazine is something of an innovation. It serves to open a window on the broad panorama of research, without which the work of the Soil Conservation Service would lack foundation. The Climatic and Physiographic Investigations with which it deals constitute one of the several important groups of studies conducted by the Division of Research. The major responsibility for the planning and assembling of material in this issue devolved upon Miss Lois Olson, in charge of the erosion-history unit. In later issues other windows will be opened, further insight given into the fundamental programs of the Division."

The number begins with a statement by C. W. Thornthwaite, head of climatic and physiographic research, of the work being done in his section. The titles of the following articles give specific instances of the scope of the program. " 'Brushing Out' the Banks of Streams," i.e. the clearing out of vegetation, is an expedient of local drainage and mosquito-control projects that may produce "many unlooked-for and serious results," both in the actual locality and up and downstream. "When is a Gully Stable?" points to dangers of renewed gullying, and "Rotation of Gully Heads" suggests a new conservation practice for gully control. "Highway Menace" (by Paul B. Sears, collaborator of the Soil Conservation Service) calls attention to loss of soil incident to highway construction and maintenance in many parts of the United States. An interesting comparison is made between Texas and Oklahoma. Texas roads are largely based on early trails and "hence upon topography." In Oklahoma roads follow grid section lines regardless of topography; this has had the "effect of superposing upon the original drainage system an entirely new pattern. The removal of vegetation is in itself sufficient to establish a pathway for water; and where rainfall is inadequate to restore a vegetative cover promptly it is the more likely to be severe when it does occur. Moreover, the higher temperatures of the Southern States, favoring, as they seem to, the production of colloidal soil material through chemical weathering, are in themselves probably conducive to rapid erosion even where rainfall is favorable to quick revegetation. Thus, the contributory part played by roads in gully erosion is to be expected in the grassland States and in the Southern States generally, except where, as in parts of Texas, it has been checked by other factors." "Erosion by Wind and Water in Oklahoma," "Ecological Relationships in the Oklahoma Climatic Research Center," and "Sampling the Weather at the Oklahoma Climatic Research Center" deal with problems in an area where intensive studies have been made. "The Problem of Soil Erosion in Ante-Bellum Virginia" illustrates the historical researches being pursued (see also *Geogr. Rev.*, Vol. 27, 1937, p. 324). "Slope Factors in Soil Erosion" gives illustrations from the Kentucky karst to show that gradient alone does not constitute all the slope problem: length of slope, exposure, form of profile, and position with respect to base level may be important.

Geography in Recent Reports of State and Regional Planning Boards. State planning boards have been established during the last three or four years in 47 states of this country. Almost every one of these "has developed new material or a new picture of the State with which it is concerned—a picture showing the type of people who live there, their probable migration into, out of, and inside the State; their problems of subsistence, income, health; in brief, how they live. The State planning

boards have examined the physical resources of the States—land, water, minerals, problems of better management of their forests, provision of better recreational facilities, the best use of agricultural lands. They have all made some progress in the study of their transportation problems, particularly the better integration of their highway systems with other methods of transportation by air, rail, or water" (State Planning: Programs and Accomplishments, National Resources Committee, December, 1936, Washington, 1937, p. vii). The volume from which this quotation is taken contains a brief statement concerning the activities of each of the boards and also a list of references to more than 1000 of their publications and reports, arranged by states. Many of the references are to typewritten manuscripts available for consultation in the library of the National Resources Committee, but others are to substantial publications. Although these documents differ from state to state in quality and scope, taken as a whole they constitute a body of source material that is of as great geographical value as are the recent publications dealing with national planning or planning for larger areas than states (see *Geogr. Rev.*, Vol. 25, 1935, pp. 177–208; *Bibl. Géogr. Internationale*, 1934, No. 2628; 1935, No. 2255 B, C). Several of the reports are veritable atlases of the physical and human geography of the states to which they apply; for example, those for Wisconsin (1934), Iowa (1934), Indiana (1934), New Hampshire (1935), New York ("A Graphic Compendium of Planning Studies," 1935), Maine (*Maine State Planning: A Bulletin of Information Issued by the Maine State Planning Board*, Vol. 1, No. 5, March, 1935), and Virginia (appearing in several volumes, 1935). To a list of reports selected with the interests of the geographer in mind (*Bibliographie Géographique Internationale*, 1935, No. 2255 A) the following references may be added: "Report of the Minnesota State Planning Board," Part 1, December, 1936; "The People of South Dakota: A Preliminary Study of Population," South Dakota State Planning Board, June 1, 1936; "Progress Report Submitted to The Vermont State Planning Board and The National Resources Committee," Montpelier, Vt., 1936; and "First Annual Report of the [Rhode Island] State Planning Board for the Year 1935."

The report for Wisconsin is exceptionally comprehensive and well conceived. It begins with a section on the "Geographic Background," in which maps are presented showing relationships between Wisconsin and the rest of the country as well as maps of the state itself. Throughout, attention has been devoted not only to present but to past conditions. In several cases Guy-Harold Smith's dot maps of the population of Wisconsin (see *Geogr. Rev.*, Vol. 18, 1928, pp. 402–421) have been used as bases on which other data, such as electric transmission lines and roads, have been plotted. This report and several of the others contain maps both ingenious in technique and out-of-the-ordinary in subject matter. In the volumes for Maine and New Hampshire, for example, the subject of recreation receives particular attention; dot maps show the distribution of summer hotels, camps, and winter-sport centers, and routes for canoe trips, etc. In the reports for such agricultural states as Indiana, Iowa, and Wisconsin the cartographical treatment of soils, climate, farm production, and rural population and social conditions is particularly full.

In addition to the reports of the state planning boards reference should also be made to three studies of interstate planning problems "which illustrate the continuing planning work discussed" in the National Resources Committee's general report on "Regional Factors in National Planning and Development," Washington, 1935 (see *Geogr. Rev.*, Vol. 27, 1937, pp. 326–327). They are published in three parts under the title "Regional Planning" (National Resources Committee, 1936). The most comprehensive of these, Part I, "The Pacific Northwest," is reviewed in greater detail in the following note. The principal recommendations made in Part II, "St. Louis Region," and Part III, "New England," call for the continuous planning activity for the two regions and for agencies established through interstate compacts with authority to carry on this activity.

A Regional-Planning Report on the Pacific Northwest. A recent regional-planning report and its mimeographed appendixes present a more complete general study of the Pacific Northwest than any that has appeared to date (Regional Planning, Part 1, Pacific Northwest, National Resources Committee, Washington, May, 1936; see also preceding note). Mention, however, should be made of the monumental 1845-page report by the army engineers on the "Columbia River and Minor Tributaries" (2 vols., *73rd Congr., 1st Sess., House Doc. No. 103*, 1933-1934), which contains basic factual material that was useful to the compilers of the report under review. The area treated includes Washington, Oregon, Idaho, and western Montana.

Charles McKinley and Blair Stewart, professors respectively of political science and economics at Reed College, have contributed a section entitled "Definition and Regionality of Pacific Northwest or Columbia Region." They feel that there is some danger of overemphasis on the geographical basis of planning. "Regional planning boundaries," they argue, "should embrace, wherever possible, whole counties and States." They take exception to a tentative proposal of the national regional subcommittee that the Pacific Northwest be divided into three regions: the maritime district in timbered Oregon and Washington west of the Cascades; the drier Columbia Basin from the Cascades to the continental divide; and central and southeastern Oregon and southern Idaho, to be attached to an intermountain area centering at Salt Lake. In spite of the great natural diversity on which this threefold division is based, McKinley and Stewart hold that the Pacific Northwest should be regarded as a unit. They believe that this area is characterized by a regional homogeneity that transcends physiographic boundaries, a unity based on commercial intercourse between, and interdependence of, unlike geographical units. Maps showing densities of road traffic, country-bank relations, and other cultural phenomena demonstrate the existence of east-west commercial and political ties. Agriculture and forestry on opposite sides of the Cascades are not so dissimilar and unrelated as to warrant their separation. Perhaps these writers have put up the old "straw man" of geographical determinism in their insistence on some of the points that they make, and it should be noted that they themselves emphasize the region-binding character of a prominent physiographic feature, the Columbia River system.

The immediate problem to be solved in the Pacific Northwest is that of the distribution of electric power from the large publicly owned dams and hydroelectric plants under construction on the Columbia. These will more than double the present installed capacity of all electric generating stations in the region; but one wonders how all the electricity will be used. A population study in the report, as comprehensive as the limited preparation time permitted, shows that the population-growth curve for the area is flattening out; it suggests the possibility that if the region becomes attractive enough, migration from other parts of the United States may check the leveling-off. Sustained-yield forestry, difficult though it may be to establish, is regarded as essential unless large areas are to become worthless. Parts of the report reflect the arid West's rosy view of irrigation. Benefits from further extension of reclamation seem to be assumed, though the need for a thorough economic survey of irrigation possibilities is realized and advocated. Can 1,250,000 acres of one-growing season land, far from present markets, be irrigated economically from the costly Grand Coulee Dam?

EDWARD L. ULLMAN

SOUTH AMERICA

The High-Water Line in the Uruguay River. In Argentina the line separating private from public property along the shore is defined by law as the limit of the highest normal high waters. In the upper part of the Uruguay River the level is subject to fluctuations depending on the precipitation in the region it drains; and

in the lower part of the river there is, in addition, the fluctuation depending on the tides. The problem of determining the line of highest normal high waters is thus not a simple one.

In an article entitled "El nivel de las más altas aguas ordinarias o más altas mareas normales (Línea de ribera en el Río Uruguay)" (*Bol. del Centro Naval*, Vol. 55, Nos. 518 and 519, Buenos Aires, 1936, pp. 55–61 and 271–281) Aquiles Armani studies the question in connection with observations covering periods of about thirty years at three points along the river. He finds the most reasonable determination to be given by the mean level of all the high waters increased by the statistical value of the dispersion of all the high waters from the mean value. He finds further that it is desirable to determine the value from 25 years of observations and that any value based on a shorter series should be considered provisional.

H. A. MARMER

Settlement Problems of Brazil and Argentina. Until the depression Brazil and Argentina, the principal immigration countries of South America, had an open-door immigration policy; but since 1930–1931 they have drastically restricted their immigration (Immigration and Settlement in Brazil, Argentina, and Uruguay, *Internatl. Labour Rev.*, Vol. 35, 1937, pp. 215–247 and 352–383). Brazil has been concerned over the change in the composition of her stream of immigration. Whereas the number of immigrants from Latin countries (except Portugal) has decreased since the World War, eastern European and Japanese immigration has increased rapidly (see also *Geogr. Rev.*, Vol. 27, 1937, pp. 145–146). The higher percentage of permanent settlers among Japanese (93.18 per cent), Poles (55.53 per cent), and Estonians, Lithuanians, and Latvians (78.17 per cent, 83.98 per cent, and 88.5 per cent respectively) as compared with Italians (12.94 per cent), Portuguese (41.63 per cent), and Spanish (51.13 per cent) has made this change in the source of immigration more effective. In consequence a quota system has been established. It allows a maximum annual immigration for each nationality of 2 per cent of the total number of immigrants of that nationality admitted to Brazil during the past fifty years.

However, this does not mean that settlers are not desired. Brazil, "after fifty years of large-scale immigration," still has an "enormous area of undeveloped land of great fertility, situated in zones in which the European can easily become acclimatised." Development of these areas depends on immigration of the right kind of colonists and on the leadership, help, and advice given to them by organizations interested in settlement. There are private settlement companies, such as the North Paraná Settlement Company, carried on for profit and dealing with the small number of settlers who are able to pay the price demanded for the land. The federal government, as well as individual states, has established official settlements on land known as *terras devolutas*. Those founded by the federal government are spread over 14 states; most of them, however, are in Paraná. There is a third form of settlement taking place: the unauthorized occupation of land, or squatting. "The district of Marilla in the State of São Paulo is a striking example of this kind of settlement: In 1920 it was still covered with scrub; yet today it has a population of 71,464, 57,833 of whom live in the rural areas." The new Brazilian constitution legalizes this type of settlement.

In recent years Brazil has developed a rapidly growing fruit industry, which should be of value to settlers as a source of cash income (compare the article by Pierre Deffontaines in this number of the *Geographical Review*). Among the fruits are, for example, oranges, which are exported to Europe between May and November, at a time when oranges from Spain and Palestine have disappeared from the markets. Of increasing importance are tobacco, oilseeds, and cotton—crops suitable for cultivation by small farmers. There is still a large and growing home market

for raw materials and foodstuffs: wheat, for example, could be cultivated in the three southern states, but most of that now consumed in Brazil comes from Argentina.

Conditions are especially interesting in São Paulo. This state, which has 16 per cent of the population of the country on 3 per cent of the territory, is the economic center of Brazil. Despite the fact that it has attracted by far the largest number of immigrants from overseas and many workers from other Brazilian states, particularly Bahia and Minas Geraes, there has always been and still is a shortage of labor, due mainly to the short stay of many of the migrants. The state itself has not been a very active promoter of settlement lest official schemes should deprive the plantations of the workers they need. The new Department of Immigration and Settlement is, however, trying to combine the interests of landowners and of immigrants by reserving land in official settlements for those immigrants who have worked for at least two years on a coffee plantation. These two years are regarded as a trial period that gives the immigrant an opportunity to become familiar with the country and the agricultural methods. This system has been used most successfully by Japanese settlement companies.

Although there is a demand for agricultural labor and cheap undeveloped land in Brazil, Argentina is deficient in both, especially on the Pampa, the agricultural and economic center of the country. There is no waste land on the Pampa. Nevertheless, the rural population density is very low, because of the agrarian structure. The land belongs chiefly to large estates, *estancias*, that use most of their land for cattle and sheep raising. A high percentage of the land under cultivation is worked by tenant or share farmers, who usually stay only three or four years on a farm. Argentines fully realize the disadvantages of the "nomadic" tenant farming system and the necessity of increased immigration. There is a strong movement that favors state action in regard to settlement. The most important step was taken in 1936 by the Minister of Agriculture, who proposed the founding of a Federal Settlement Institute. According to the bill the Settlement Institute will take over state land suitable for settlement and is empowered to buy private land, especially estates that have become the property of official banks. The land will be divided into lots of farm size and will be sold under conditions that should make it easy for settlers finally to become the owners of the farms they operate.

Settlement possibilities in Patagonia are limited to the valleys of rivers that could be used for irrigation and to small areas along the Andes where rainfall is more abundant. However, it is not probable that agricultural settlers will be attracted to these regions as long as the market problem remains unsolved. The Andean provinces offer no opportunities to settlers because their main industries, wine and sugar, suffer from overproduction, so that the authorities are forced to prevent the development of new land. Of special interest are the three northern national territories of Formosa, the Chaco, and Misiones, where most of the land still belongs to the government. The main crops are yerba maté, in Misiones, and cotton, especially in the Chaco. Yerba-maté production has increased so rapidly since the World War that a tax of 4 pesos has to be paid for each new tree. Agricultural colonization in Misiones depends therefore on the possibility of finding another cash crop: land is still available at a relatively low price (see also T. Brinkmann: Der Yerba Mate-Bau im argentinischen National Territorium Misiones als Grundlage bäuerlicher Siedlung, *Berichte über Landwirtschaft*, Vol. 11 (N.S.), 1930, pp. 403–442). The cultivation of cotton has increased rapidly in recent years, and it is estimated that, in addition to the 300,000 hectares already under cotton in Argentina, 700,000 hectares are available to be put under cultivation if the market permits. These 700,000 hectares include 435,000 hectares in the territories of the Chaco and Formosa, where most of the cotton is grown by small farmers who work with their families and a few hired laborers, many of them Indians. However, cotton growing in the Chaco is full of hazards (compare the gloomy picture presented by Hans Tolten in "Enchanting

Wilderness: Adventures in Darkest South America," London, 1936). Most of the cotton growers who started in the years 1918–1924 without much experience were bitterly disappointed in 1925–1927 when crops failed entirely (see T. Brinkmann: Ackerbau und Kolonisation im argentinischen Chaco, *Berichte über Landwirtschaft*, Vol. 12 (N.S.), 1930, pp. 499–540). According to statistics comparing costs of cotton production in the Chaco and North America, the North American cotton farmer produces at greater cost up to the point of harvesting, because of higher prices of land and the necessity to use fertilizer. The Chaco farmer loses most of his advantage at harvesting, because of the scarcity and high wages of laborers. It will probably be several years before cotton production is firmly established in the Chaco and the cotton farmers have had enough experience to use the proper methods of cultivation and have accumulated sufficient financial resources to overcome crop failures.

KARL J. PELZER

The Germans of Rio Grande do Sul. The present cultural, social, and economic status of the German settlements in Rio Grande do Sul is discussed in a study by Karlheinrich Oberacker (Die volkspolitische Lage des Deutschtums in Rio Grande do Sul (Südbrasilien), *Schriften des Instituts für Grenz- und Auslanddeutschtum an der Univ. Marburg*, No. 9, 1936). In 1924 the Germans of Rio Grande do Sul celebrated the one hundredth anniversary of the arrival of the first German colonists who settled at São Leopoldo, north of Porto Alegre. The colonists, who found that the southern part of the state—mostly open grassland—was occupied by Portuguese cattlemen, pushed into the mountain forests of the *serra* in the northern half of the state. Until 1870 the Germans were practically the only colonists. Since then a large number of Italian settlement areas have developed. Beside pure German and Italian communities are others of mixed population, which are preferred by the Brazilian authorities because of the greater possibility of assimilation.

There are three distinct areas of German colonization: (1) a continuous east-west zone 220 to 240 kilometers long and 30 to 50 kilometers wide north and west of the Jacuhy River (some of these settlements are described by Mark Jefferson: Pictures from Southern Brazil, *Geogr. Rev.*, Vol. 16, 1926, pp. 521–547); (2) an area north of Pelotas, in the Serra do Cangassù (Oberacker calls it Serra do Tapes, which is farther west); (3) several separate districts spread over the serra as far as the Uruguay River. Wherever Germans form the majority of a community, they have kept their culture and language and have not intermarried with Lusos (Brazilians of Portuguese origin). However, they show less resistance to the process of assimilation in cities and agricultural communities of mixed population. In contrast with the Lusos, most of the settlers are small farmers. Their families are large, and this leads to a steady need for new colonies.

Politically as well as economically the Germans play a more important role than their number (14 per cent) would indicate.

KARL J. PELZER

A Forest Reserve in Brazil. A large area in the Itatyaia region mentioned by Professor Deffontaines in his article in this number of the *Geographical Review* has been acquired by the Brazilian government for a forest reserve and botanical station (see A. R. Netto: Á região do Itatyaia e ás Agulhas Negras, *Geografia*, Vol. 2, No. 2–3, São Paulo, 1936, pp. 13–21). In common parlance the name Itatyaia (a spelling that Netto defends against the commoner Itatiaya) is applied to the central mountain group of the region whose highest peak, Itatyaiussú, is the second highest in Brazil. Actually Itatyaia is a regional name, and the group of mountain peaks that dominates it is properly called the Agulhas Negras. Until 1911, when Faustino de Freitas climbed Itatyaiussú, to ascend it was considered impossible. Since then it

has become a popular climb for amateurs as well as professionals; and, with the establishment of the forest reserve and the cutting of bridle paths to the foot of the peak, the region promises to become a favorite recreation resort.

At the end of the nineteenth century the entire region surrounding the Agulhas Negras was a single enormous fazenda, owned by Irenêo Evangelista de Souza, the Viscount of Mauá. In spite of the fact that even cattle raising had proved unsuccessful on this fazenda because of insect pests, which made year-round occupation of the region impossible for both man and beast, attempts were made with government aid to colonize the region with Belgians, Germans, and Swiss. This experiment was of short duration, however, and the region was soon deserted so far as permanent residence is concerned.

EUROPE

A Recent Study of Changing Tidal Channels and Coast Lines in the Netherlands. The northward-moving current along the Dutch coast, combined with the strong tidal action among North Sea islands, causes considerable alterations in configuration of the shallow sea bottom. The ever-shifting channels among the islands have been, since medieval times, a matter of great concern to the commercial cities of the Zuider Zee. Though the channels have lost much of their significance in the last century, they still are important for local and coastwise shipping. Besides, the islands themselves have been and are much affected by the interplay of water, wind, and sand: their form and location have changed considerably in historic times.

An article by J. H. van der Burgt (Veranderingen in den zeebodem van het zeegat van het Vlie en in de kustlijn der Waddeneilanden Vlieland en Terschelling, *Tijdschr. Kon. Nederl. Aardrijksk. Genootschap*, Vol. 53, 1936, pp. 802–823) contains valuable information on the historic sequences in the Vlie (the gap between Vlieland and Terschelling) and its outer and inner approaches. The paper is based on research conducted in recent years by the Netherlands government (Studiedienst der Directie Benedenrivieren van Rijkswaterstaat). A number of charts and maps are available for comparison, the first dating from the middle of the sixteenth century. The surveys from before 1800 lack the reliability of the later ones, owing to less exact surveying instruments (see the article by Miss A. W. Vlam in the same issue, pp. 794–801); but they are helpful in analyzing the principal changes. The author has added a plate with copies of early charts, together with those of modern charts, all redrawn to the same scale. Conclusions of the analysis may be summarized as follows: At high tide the sand-laden current comes from the west and tries to reach the inner basin by the shortest way, i.e. along the Vlieland side of the gap; the same is true for the ebbing waters. Accumulation of sand gradually forces the main channel more and more to the Terschelling side. As it approaches the end of its northward wandering on the shoals of Terschelling, the detour has become so great that the tidal currents begin to cut again through the sandbanks near the Vlieland shore. The main outlet switches back to this side, starting the process all over again. The enclosure of the Zuider Zee has strengthened the tidal movement, but as yet its effects are not to be measured, though it is expected that they will be considerable.

As for the islands, the west coast of Vlieland has retreated more and more, so that since the end of the seventeenth century a belt of one to two kilometers in width has disappeared, including the entire southwest end of the island and its village of West Vlieland. The reason for this seems to be that in the seventeenth century the shoals north of Texel (Eierlandsche gronden) have shifted, leaving the western tip of Vlieland exposed to the currents. Water and wind action formed a large sand flat (the Vliehors) south of what once was West Vlieland. In recent years the government has taken measures, by placing screens and later by revegetation, to create a new dune wall on the Vliehors.

Terschelling has suffered in historic times far less than Vlieland, being better protected by the more extensive outer shoals of the Vlie. The village of West Terschelling, on the southwestern tip of the island, has at intervals been threatened on one or another side by the Vlie channels. Extensive piers and dams have been built to change the direction of the currents and stop the scouring action.

JAN O. M. BROEK

ASIA

The Boat People of Shanam. "The Boat People of Shanam" is a social survey of a sample of the vast "floating" population, "Tanka," scattered up and down the banks of the West River in Kwangsi, the Pearl River in Kwangtung, and the Min River in Fukien. Some of the Tanka live exclusively on boats, others in huts or pile dwellings along the shores, as do the Shanam group described by Wu Yuey Len (*Nankai Soc. & Econ. Quart.*, Vol. 9, 1936–1937, pp. 613–665 and 807–854), who occupy the shores of an island in the Pearl River delta. The Tanka are a remnant of one of the aboriginal tribes of southwestern China; they represent "the lowest stratum in the social stratification of the society of Canton . . . , a definitely underprivileged, disinherited and landless class." Until the establishment of the republic they had suffered "disabilities from time immemorial. . . . 1. They were not allowed to own land or to live on land. 2. They were prohibited from intermarrying with land people. 3. They were not allowed to attend schools and to take the government examination. 4. They were not allowed to hold governmental offices. 5. They were not allowed to wear silk clothing." These very disabilities have enabled them to survive intact as a racial, social, and cultural group. "This group has fitted itself perfectly into the exigencies of the situation, economically. Forced as they are to live out their whole life in boats or on pile-dwellings on shore they have gravitated in their occupations along lines for which they are best suited. The able-bodied men usually work as longshoremen or stevedores on the salt junks, or act as pilots, sailors, firemen, deckhands on the inland river barges and boats. The women row their fares in little sampans back and forth, up and down the Pearl River. Again, men, women and children may go out to work in the dike farms, ponds and rice fields among the many sandbars and delta-islands on the Pearl River Estuary."

The Min Valley Gorge. In the article "Notes on the Human Geography of the Chinese-Tibetan Borderland" Paul Huston Stevenson pointed out the great geographical contrasts to be seen along the famous trade route from Chengtu to Tachienlu (*Geogr. Rev.*, Vol. 22, 1932, pp. 599–616). The similar conditions farther north in this borderland are described by Professor George D. Hubbard. "Geographic Significance of the Min Valley above Chengtu, West China" (*Bull. Geogr. Soc. of Philadelphia*, Vol. 33, 1935, pp. 76–87) and "Min River Section between Kuan-hsien and Wei-chou, Szechuan, China" (*Bull. Geol. Soc. of America*, Vol. 48, 1937, pp. 123–151) give results of a journey made several years ago in the company of the distinguished and late-lamented missionary-explorer J. H. Edgar.

"This is a deep, youthful valley with steep, rocky slopes among mountains, which rise to an altitude of more than 8,000 feet, and peaks, 15 miles west of Wei-chou, which attain more than 11,000 feet. The altitude of the valley floor descends from about 4,400 feet at Wei-chou to 2,500 feet at Kuan-hsien, or nearly 50 feet in a mile, producing almost continuous rapids." The uplift that permitted the cutting of the Min gorge and the building of the great Chengtu fan "may be correlated with the disturbance that gave the Yangtse River opportunity to cut the gorges above Ichang."

Kwanhsien is a political center and the residence of the engineers who control

the waters of the upper part of the Chengtu plain, as it was of their famous predecessor the great Li Ping, who devised the system more than 2000 years ago. Weichow is at a meeting point of routes and is an important trading center with a typically mixed population—Tibetans, native tribesmen, Chinese. Here "a curious combination of languages is found on a pillar where occurs an inscription in Chinese characters but Sanskrit language, a witness to the ancient use of the highway." The highway itself is simply a narrow paved path, along which flows a constant stream of traffic—"hides, furs, wool, soda from some salt lake, saltpeter . . . , gypsum, rhubarb, licorice roots, and many herbs" going down, and a return commerce of "many manufactured goods; as rugs, carpets, cloth, scarfs, tools and utensils; of rice, bricks of tea, sugar, and oils almost wholly vegetable in origin."

AUSTRALASIA AND OCEANIA

Rice Farming in Hawaii. Rice farming is a dying industry in Hawaii (J. W. Coulter and Chee Kwon Chun: Chinese Rice Farmers in Hawaii, *Univ. of Hawaii Research Publs. No. 16*, 1937). Today the Islands import about 85,000,000 pounds of rice a year from California as against 5,000,000 pounds produced at home; some rice is also imported from Japan. This is a very different state of affairs from that of the 1860's, when a market for rice in California to feed the rapidly increasing numbers of Chinese gave a stimulus to the nascent cultivation in the Islands. By the turn of the century rice cultivation in Hawaii had reached its peak. Simultaneously circumstances set in motion by the annexation of the Islands by the United States (1898) were in train to bring about its decline. The supply of cheap Chinese labor was cut off. An impetus was given to the production of sugar cane, which in many ways conflicts with rice. The introduction of Japanese laborers for the cane fields did not create an increased demand for home-grown rice, as might have been expected, for the Japanese greatly preferred the varieties to which they were accustomed. The island rice growers had to face competition on the mainland. In the Sacramento Valley one rice farm measures 9000 acres, another 7000 acres—more than the total area under cultivation in Hawaii at the time of maximum production. By airplane the rice fields can be sown at the rate of four acres in ten minutes; harvesting can be done by combined harvester-thresher. A table of comparative costs is eloquent: in sum, it shows a net loss of $2.85 an acre on Hawaiian rice, a profit of $19.57 on Californian rice.

WORLD AS A WHOLE AND LARGER PARTS

Climates of South Africa and New Zealand. The article "An Informal Discussion of the Climate of South Africa," by T. E. W. Schumann, chief meteorologist of the Union of South Africa, marks a new departure in the *Quarterly Journal of the Royal Meteorological Society* (Oct., 1936, pp. 552–559). The article was written to " 'give the ordinary man a concrete idea of the way in which the climate works out in practical life—how he can keep fit, what crops suit the different parts of the country, and so on.' " This successful effort at "popularization" is helped by the accompaniment of a number of excellent photographs; for example, there are the "vineyards and orchards of the Hex River Valley, which falls within the winter rainfall area of the Cape Western Province," and a typical scene in the "Lowveld" of the eastern Transvaal, Kruger National Park, where the rainfall "is very moderate, nowhere is the bush very dense, and the rivers flowing through the park are mainly fed from the Drakensberg escarpment, which lies towards the west and enjoys a much higher rainfall."

On similar lines is "The Climate of New Zealand" (*Quart. Journ. Royal Meteorol. Soc.*, Vol. 63, 1937, pp. 83–92), by E. Kidson, Director of Meteorological Ser-

vices of New Zealand. His paper is rather more systematic and enters into explanations of various climatic phenomena, but it remains no less interesting from the "practical life" point of view, as a quotation or two will illustrate. The daily range of temperature is surprisingly wide for an insular country, and this "is probably a valuable bracing influence in the climate. It is important in connection with many industries in which conditions of temperature and humidity are involved. In the writer's opinion, the magnitude of the variation is due to the frequency with which subsidence occurs in the atmosphere, particularly in cold air masses, and the absence of pollution. At the same time, there is little chance for the air to stagnate in any one area for a prolonged period and the high relief of the country militates against the formation of continuous cloud sheets." "The range of temperatures experienced is extremely favourable to the growth of pasture." "The föhn winds [experienced on the wheat-growing Canterbury plains], though otherwise beneficial, are liable to shake the ripe grains from the ears and this has been combated by growing a tight-glumed variety."

Dr. Kidson's paper is also illustrated with photographs well selected and admirably reproduced. It is to be hoped that the *Journal* will publish other material of this type: teachers of geography should find it particularly useful.

Wheat beyond the Arctic Circle. Among the triumphs of scientific agriculture is the evolution, through selection and crossing, of types of wheat that have spread its cultivation into sub-Arctic lands. The Russians, as part of the effort to develop their vast Arctic territories, want to extend wheat cultivation north of the Arctic Circle. C. A. Flaksberger and M. I. Smirnova in "Wheats beyond the Arctic Circle" (*Bull. of Applied Botany, Genetics and Plant Breeding*, Ser. 15, No. 5, 1936, pp. 3–36 and 92–93, in Russian with an English summary) give the results of experimental growing of wheat from 1923 to 1933 at the Polar Station of the Institute of Plant Industry, near Khibiny, 67° 44′ N. They record that in Canada wheat is grown up to 8° south of the Arctic Circle and in Alaska, along the Yukon Valley, from 61° to 65° 30′ N., hardy varieties of wheat are a regular crop. In the U.S.S.R. the northernmost point of cultivation in Europe is 66° N., in Siberia, 64° N., though experimental sowings are being made at Khibiny, in European Russia, and at Verkhoyansk, 67° 34′, in Siberia. In individual years ripened grain has been produced in both these places. The article, however, deals mainly with the results obtained from eleven years' sowing at Khibiny of varieties of wheat from almost every part of the world.

The climate is severe. Sowing cannot be done until late May or early June; ripening should be complete by the end of August or the first week in September; temperatures in late July and August, i.e. at the vital stage between earing and ripening, are low. In 1926 no grain ripened because, in addition to these difficulties, the wheat had to struggle against spring drought and persistent cold winds later. The average temperature for June to September inclusive for one year was 10.1° C.; for the years 1924–1928 it was 10.9° C. The average rainfall for 1924–1928 was 201 millimeters. Rainfall varies markedly; for example, 20.8 millimeters in June, 1928; 163.6 millimeters in June, 1931; 141.1 millimeters for June-September, 1930; 364.8 millimeters for June-September, 1932. Minimum and maximum average monthly temperatures from 1924 to 1932 were: June, 6.7° C., 10.2° C.; July, 11.2°, 17.7°; August, 11.1°, 14.7°; September, 4.3°, 8.5°. Yet in most years a few varieties of wheat ripened fully, and many more attained "yellow" or "waxy" ripeness.

The most promising varieties of wheat for acclimatization to the conditions at Khibiny are the "early northern" (group *hyperboreum*), which in most years yielded good grain either in the "waxy" or in the complete stage of ripeness. The most unfavorable years are those in which cold winds during the earing-ripening period cause sudden sharp lowering of the temperature. A variety of wheat capable of withstanding such years has not yet been evolved, but the Russians working in

Khibiny hope that their experimental crossings will result in the evolution of a type of wheat suitable for cultivation even in the severe conditions of Khibiny and the Arctic Russian lands generally. (H. P. Smolka in "The Economic Development of the Soviet Arctic," *Geogr. Journ.*, Vol. 89, 1937, pp. 326–343, makes interesting reference to experiments in grain cultivation being carried out on the State farm, "Transarctica," at Port Igarka on the Yenisei, 67° 27′ N.)

R. M. FLEMING

POLAR REGIONS

Collaboration in Glaciologic and Meteorologic Research: the Norwegian-Swedish Spitsbergen Expedition. Few events in the march of science are so pleasant to contemplate as the collaborations occasionally entered into by two men who have independently reached a point at which each is in a position to contribute to the solution of problems encountered by the other and to receive from him assistance in solving his own. The present note is concerned with the fruits of such a productive collaboration: the "Scientific Results of the Norwegian-Swedish Spitsbergen Expedition in 1934" (Introduction and Parts I–VIII, *Geografiska Annaler*, Vol. 17, 1935, pp. 22–88 and 145–218; *ibid.*, Vol. 18, 1936, pp. 34–73 and 225–244). The two principals in this enterprise were Professor H. W. Ahlmann, who has published a preliminary account of the expedition elsewhere (Contribution to the Physics of Glaciers, *Geogr. Journ.*, Vol. 86, 1935, pp. 97–113), and Professor H. U. Sverdrup. For Ahlmann the expedition was "a sequel to the Swedish-Norwegian Arctic Expedition in 1931" (cf. *Geogr. Rev.*, Vol. 25, 1935, pp. 313–316), an opportunity to carry out "a more detailed and rational investigation of the physical processes important in the life of glaciers." For Sverdrup it provided facilities for investigating the exchange of heat between a melting snow surface and the air above it, a simplified case of the general problem of the exchange of energy and matter between the earth's surface and the atmosphere.

The four members of the expedition were on Isachsen Plateau, a large firn field in West Spitsbergen, from June 23 to August 16, 1934, their headquarters being located in latitude 79° 9′ N., longitude 12° 56′ E., at 850 m. elevation. Their glaciologic observations included a study of the stratification of the firn and—to the extent possible with limited equipment—of its fine structure, a continuous record of ablation obtained by means of an "ablatograph" Ahlmann has described earlier (Determination of the Ablation of Snow and Ice, *in* Hyllningsskrift tillägnad Sven Hedin på hans 70-årsdag den 18 febr. 1935, Stockholm, 1935, pp. 470–480), and measurements of total ablation on and movement of the Fourteenth of July Glacier, by way of which the party traveled between the coast and Isachsen Plateau. A record of firn temperatures was obtained by the joint efforts of the glaciologic and meteorologic personnel. The program of meteorologic observations included records of wind velocity at 7, 2, and 0.3 m.—and occasionally at 4 cm.—above the surface, temperature and humidity of the air at 5 and 1 m. and at 4 cm., total incoming radiation, and albedo of the snow surface.

These observations surpass in completeness and detail all earlier measurements directed toward an understanding of the physics of glaciers. They yield full information on the following: net yearly accumulation on Isachsen Plateau during the period of ten years ending with 1934; annual march of temperature in the firn and the relation of this march to the fate of the thaw water produced in summer; the respective contributions of radiation, convective transfer in the air, and condensation of water vapor to the heat used in ablation; and the material economy of the Fourteenth of July Glacier in 1933–1934. For the first time the part played in ablation by the latent heat released when water vapor is condensed on a snow surface is evaluated. This is no insignificant factor when the temperature of the air is above freezing: it accounts for nearly 15 per cent of the total ablation during the period of

observation. All these results contribute to the systematic glaciology toward which Ahlmann has long been working; in particular to his definitions of physical differences among the glaciers found in different climates.

Sverdrup has used the observations as the basis of far-reaching conclusions regarding the vertical transport of heat, water vapor, and momentum in the lowest layer of air. A melting snow surface is the best "ground" surface in nature for investigations of the sort he undertook: its temperature is known, since it is constant at 0° C., the vapor pressure at the surface is constant at the saturation vapor pressure appropriate to that temperature, and all the heat received by it is used in ablation. A continuous record of incoming radiation was kept, and outgoing radiation was computed. The transfer of heat to the snow surface by turbulent convection and condensation of water vapor could accordingly be segregated as the difference between total heat added (heat of fusion of all the snow melted) and the net balance of radiation.

With this information and the record of the meteorologic elements at different heights Sverdrup could proceed to the solution of several important problems concerning the behavior of turbulent fluids near a bounding surface. His outstanding theoretical result is proof, not established before, of the identity of the coefficients of transfer of momentum (eddy convectivity or virtual friction) and of transfer of heat and admixtures (eddy conductivity or Austausch coefficient) in turbulent fluids. His theoretical results are published independently (The Eddy Conductivity of the Air over a Smooth Snow Field: Results of the Norwegian-Swedish Spitsbergen Expedition in 1934, *Geofys. Publikasjoner*, Vol. 11, No. 7, Norske Videnskaps-Akad. i Oslo, 1936). In addition to this full treatment, he has summarized his principal conclusions in a shorter paper (Austausch und Stabilität in der untersten Luftschicht, *Meteorol. Zeitschr.*, Vol. 53, 1936, pp. 10–15) and applied them to the problem of evaporation from the sea surface (Das maritime Verdunstungsproblem, *Annalen der Hydrogr. und Marit. Meteorol.*, Vol. 64, Hamburg, 1936, pp. 41–47). Those to whom the linguistic barrier is less formidable than the mathematical will find them presented less elaborately but instructively in his lectures before general audiences (Varmeutvekslingen mellem en sneflate og luften, *Beretninger fra Chr. Michelsens Institutt for Videnskap og Åndsfrihet*, Vol. 5, 1935, Part III; and Turbulensforskning i laboratoriet og i naturen, *ibid.*, Vol. 6, 1936, Part V).

JOHN LEIGHLY

THE OCEANS

Progress in Oceanographic Research. At the April meeting of the section of Oceanography of the American Geophysical Union, in Washington, D. C., an assemblage of record size considered a program concerned with the development of oceanographic work in North America during the preceding year.

Three departments of the United States government, namely the Hydrographic Office, the Coast and Geodetic Survey, and the Coast Guard, reported on soundings, triangulation, and hydrodynamic studies in all the oceans and other great bodies of water adjacent to the continent. Because of the extensive sonic surveys of the U.S.S. *Ramapo*, the northern part of the North Pacific is becoming practically as well known as more frequently traversed oceans. In the North Atlantic investigations by the Coast Guard, as related by Commander E. H. Smith of the Ice Patrol, indicate that the cold bottom water, sometimes detectable as far south as latitude 43° N., has its source in the Labrador Sea and is the result of winter cooling and sinking of surface water in the broad stretch between Labrador and Greenland. During the summer of 1936 the Labrador Current was characterized by greater volume and lower average temperatures than usual.

Canadian authorities contributed two papers dealing with the Pacific littoral. The University of Illinois, the Scripps Institution of Oceanography, the Carnegie

Institution of Washington, and the Woods Hole Oceanographic Institution were also represented on the program, the staff of the last organization contributing three papers.

Most spectacular among new discoveries was a series of cores obtained from the bed of the North Atlantic by Dr. Charles S. Piggot of the Geophysical Laboratory, which were described in a preliminary report by five specialists. Previous sedimentary material from the deep ocean basins had been chiefly in the nature of "grab samples," representing little more than scrapings of the bottom. The new specimens, however, comprise cross sections as much as ten feet long and were obtained by shooting a tensile steel tube from a mortar lowered to depths as great as 2640 fathoms (three miles). Cannon and projectile are linked together by loose chains, and when the device is hoisted to the surface, the tube is filled with a core two inches in diameter. In the undisturbed depths far from land sedimentary accumulation is extremely slow, and the serial sections obtained across the North Atlantic permit a reading of the history of ocean events, including phenomena of successive periods of glaciation. The technique of such field work proves no less significant than specific information obtained from the first bottom samples.

Of notable importance is the continued charting of contours on the continental slope along both Atlantic and Pacific coasts of the United States. A detailed new map exhibited by Professor Francis P. Shepard showed the extraordinarily marked canyon formation west of California, together with a series of grabens and horsts lying between the present shore and the great scarp at the edge of the shelf. Both horizontal and vertical movement has been pronounced in this submerged area. The topography, which is even more rugged than echo soundings indicate, suggests that the present San Francisco river drainage formerly entered the Pacific at Monterey.

Dr. H. U. Sverdrup, appearing for the first time as Director of the Scripps Institution, told of the approaching equipment of a 104-foot Diesel schooner, which would enable his staff to attack more effectively problems concerned with the currents and complicated bottom contours off the Californian and Mexican coasts.

As is now well known, there is no direct connection between the submarine valley of the Hudson River and the outlying deep canyon that descends the continental slope. The inner valley ends in a shelf, somewhat resembling a delta fan, at depths between 40 and 50 fathoms, whereas six miles north the great canyon continues its eastward course. Professor Shepard, who was one of several speakers to refer to the anomaly, suggested that the former mouth of the river may have become displaced northward to this extent by the formation of a coastal bar during earlier sea levels, lower than the present stage.

As regards factors that caused the formation of the submarine canyons now receiving so much attention, H. C. Stetson demonstrated that normal tidal currents might be ruled out. Working from the *Atlantis*, this investigator lowered Ekman current meters, suspended in a weighted frame or cage, into canyons of Georges Bank at depths of more than 200 fathoms. In this region the surface tidal currents are rotary, but those in the canyons are so affected by the relief that they flow in and out. The speed of all tidal currents near the bottom proved insignificant as an erosive agent, though it might perhaps be sufficient to prevent redeposition of fine sediment in existing channels.

H. R. Seiwell, also of the *Atlantis* corps, reported on vertical movements, i.e. depth waves, in the troposphere northwest of Bermuda as measured by daily oscillations of temperature and oxygen content, measured at frequent intervals and precise levels.

Columbus Iselin, commander of the *Atlantis*, related new plans for coöperative investigation of North Atlantic circulation. One of these will include simultaneous work by at least six vessels, representing several nations, in the summer of 1938. During a common period carefully correlated sections will be made along a number

of lines in the easterly drift between the Grand Banks and the European side of the Atlantic. Such studies, when all worked out together, should yield far more exact information than has yet been obtained with regard to a number of problems of both hydrology and meteorology.

ROBERT CUSHMAN MURPHY

Oxygen in the Sea. Quite apart from the oxygen held in chemical combination in the water particles, the sea contains free oxygen dissolved in the water. A knowledge of the oxygen content in the sea is obviously of importance to the marine biologist, since animal life in the sea is dependent on it. But it was not until the beginning of the twentieth century that a practical method for determining the quantity of dissolved oxygen in sea water was developed. Since that time this question has become of importance to the oceanographer also; for differences of oxygen content in different places may arise as a result of currents and thus may aid in bringing to light slow movements within the depths of the sea.

In a discussion of this question under the title "L'indice d'oxygénation dans les eaux marines" (*Rev. Gén. des Sci.*, Vol. 47, 1936, pp. 655–662) Camille Vallaux directs attention to this promising field of research and summarizes briefly existing knowledge relative to the problems involved. The principal researches have been made by German oceanographers in the Atlantic and by Americans in the Pacific. As Vallaux remarks, the Germans have emphasized the dynamic features interpreted through the variation of oxygen content, whereas the Americans lay stress on the biologic factors, such as the release of oxygen through photosynthetic processes and consumption by respiration of marine animals.

The investigations in the different oceans have shown conclusively that the oxygen content of the sea varies both horizontally and vertically. But in interpreting such variations Vallaux points out that three different types of explanation are possible: static, dynamic, and biologic. The static interpretation places emphasis on the differences in power of oxygen absorption by sea water under different conditions of temperature, salinity, and pressure. The dynamic interpretation stresses the movements in the depths of the sea relative to the surface. The biologic interpretation is based on the two opposing effects of oxygen production by phytoplankton and oxygen consumption by zoöplankton.

Two important features of the oxygen distribution in sea water have been brought to light by observations: the existence of a minimum oxygen content near the surface and the increase of oxygen content in the depths. According to the static interpretation, the existence of the minimum is explained by the lower oxygen saturation of the surface water on account of the higher temperature of the upper layers of the water. Biologically it can be explained by the total disappearance of phytoplankton in the depths of the sea and the abundance of zoöplankton in the lesser depths. The increase of oxygen content in the depths of the sea is, according to the static interpretation, due to the increased capacity for holding oxygen in solution on account of lower temperature and greater pressure of the water. Dynamically it is explained as due to an equatorward movement of the cold water from the Polar Regions; and according to the biological interpretation it is due to the decrease in zoöplankton. Vallaux closes by saying that he makes no attempt to solve the problem but merely indicates its broad outlines, "for at the present time nothing more can be done."

H. A. MARMER

MATHEMATICAL GEOGRAPHY

Daylight-Saving Time. The last paragraph of the very instructive paper on "Universal World Time" by Miss Helen M. Strong in the *Geographical Review* (Vol. 25, 1935, pp. 479–484) is devoted to daylight-saving time, a subject upon which

no comprehensive account seems to exist, hence the following notes may be of interest. It may first be observed that outside of the United States and Canada it is not left to the discretion of individual communities whether to introduce daylight-saving time or not, but the matter is regulated, by law or decree, uniformly for the whole territory of the countries concerned. "Whitaker's Almanack" generally publishes a list of the countries having adopted the measure (p. 188 in the 1937 edition. "This list may not be complete." See also p. 190 for note on introduction of summer time into Great Britain.) In 1937 daylight-saving time in its usual form (i. e. by advancing the clock by one hour during the summer months) was kept in Europe in Belgium, France, Great Britain and Northern Ireland (including the Channel Islands and the Isle of Man), the Irish Free State, Luxemburg, Monaco, the Netherlands, and Portugal, and in America (outside of the United States and Canada) in Argentina, the Falkland Islands, and Newfoundland (including Labrador). In New Zealand time is advanced by 30 minutes only. Since 1933 Chile has used standard 60° W. longitude time throughout the year. Miss Strong rightly states that the measure is effective only in mid-latitudes, but there are several tropical countries where it has been adopted: in British Honduras the clock is advanced by 30 minutes from the beginning of October to the middle of February, in the Gold Coast Colony by 20 minutes during the last four months of the year, and in Sarawak also by 20 minutes from September 14 to December 14. In Soviet Russia the observance of daylight-saving time (advance of an hour on standard time) the year round was decreed in 1930 (June 16). The 45th meridian time, or daylight-saving time of the Moscow zone, is the standard time for railways and commercial aviation in the whole territory of the Soviet Union.

Daylight-saving time was discussed in Great Britain (bill introduced into Parliament in 1908) and Germany (advocated in 1912 in *Die Woche*) before the war. During the war a *Sommerzeit* was actually introduced into Germany on May 1, 1916; Austria followed almost immediately; and England on May 17. Though it was stated that an annual saving of no less than 90 million marks resulted for the household of the German government alone, the measure met with much opposition, especially from the rural population, and after the war daylight-saving time in Germany and other Central European countries was discontinued.

However the advocates of these measures cannot boast to have "invented" daylight-saving time, for it had been kept for four or five centuries in the Swiss town of Basle. A great number of travelers of the sixteenth, seventeenth, and eighteenth centuries relate that the clocks at Basle were one hour faster than those of the neighboring towns and villages. This special "Basle time" fell a victim to the French Revolution, but there was a certain agitation in favor of its reintroduction for the whole country (i. e. for the adoption of the thirtieth instead of the fifteenth meridian time) when Switzerland passed from local to standard time. The origin of "Basle time" is unknown. There is a tradition that it had been introduced during the Council of Basle (1431–1443) to make lazy delegates punctual in attendance at the morning meetings. According to another version, in 1271 a plot against the Patrician Government had been frustrated by the sexton of the Cathedral advancing the clock by one hour. But it is more probable that some medieval town father gifted with a speculative mind found it more correct to begin the day with one than with twelve o'clock. (In reality the day of course does not begin at 12 p. m. of the preceding day, but at 0 hours 00 minutes.) This hypothesis is corroborated by three facts: (1) the daily life of the citizens of Basle, referred to true local time, was exactly the same as elsewhere, only the denomination of the hours differed; (2) most clocks and watches at Basle had topmost on their faces not the figure XII but the figure I; (3) a document dating from the fifteenth century casually speaks of "midnight, when the clock strikes one."

CARL HANNS POLLOG

PHYSICAL GEOGRAPHY

Work of the International Commission of Snow. The International Commission of Snow, authorized by the International Association of Scientific Hydrology at Lisbon in 1933, held its first gathering in Edinburgh, September, 1936, as part of the International Union of Geodesy and Geophysics. The Snow Commission's program was made purposely broad to create a background of universal interest and to point out the many needs to be served. In outline the subjects included Measuring Precipitation, Snow Cover and Snow Surveying, Influence of Snow on Runoff, Avalanches, Transport, Ice on Lakes and Rivers, Physical Properties of Snow and Ice, Glaciers, Icebergs, Reports of Recent Expeditions to the Arctic and Antarctic, and Apparatus. It is hoped to publish the proceedings in full.

The next international meeting is to be held in Washington in 1939. Officers of the Commission representing the three main fields of investigation are J. E. Church (United States), President, Snow; Antoni B. Dobrowolski (Poland), Vice-President, Ice; Peter Stakle (Latvia), Secretary, Cold.

The problems formally assigned for investigation and report in 1939 are: (1) The permeability of snow to water; the capacity of the snow to retain water. (2) Influence of snow and ice on the flow of streams with reference to the condition of the ground, as to whether it is normal or frozen, and to condensation. (3) Compilation of snow maps of all countries. Informal activities include the interchange of information on all problems of snow and ice. In illustration the following problems referred to the Commission may be mentioned: explanation of the cause of the abnormal and seemingly persistent low minimum flow in the Punjab, India; and review of a new method of selecting sites for snow-survey courses on the upper Columbia River in British Columbia.

Mountaineering and exploration are already including snow surveying in their programs. A Mt. Rose snow sampler was requested by the American-British Expedition to the Himalaya Mountains in the summer of 1936, and others have been requested by an American expedition planning to return to the Greenland icecap. Dr. Frederick W. Lee, chief of the Geophysical Division of the U. S. Geological Survey, has developed a light electrical resistivity meter to measure the depth of snow and ice, and John C. Stevens has developed a portable springless balance for weighing evaporation pans. Snow Sports are being added as a division in close association with Avalanches. In America forecasts have already been begun regarding winter-sport conditions in the national parks, and in the future radio broadcasts on them will be given in connection with those on snow surveys.

Akin to all this, although carried on as pure research by the Central Geophysical Observatory at Leningrad, is a Soviet investigation of snow crystals under differing meteorological conditions. This investigation would be of practical interest in the Arctic, where the Eskimos have several names for snow and are as interested in the effect of various types on the slipping of their sledges as a skier is in the various kinds of ski wax. The government of Argentina has now started a comprehensive snow-survey system, and the scientists of Argentina and Chile are investigating high mountain snows, such as the *niève pénitente*.

It is proposed to hold meetings of national groups in the interval between international gatherings. The British group is already fully organized, and a report of its activities by its chairman, Gerald Seligman, former president of the Ski Club of Great Britain, is given in illustration. At the December meeting L. C. W. Bonacina read a paper on "Survey of Snowfall in the British Isles, and Problems Needing Investigation in the Scottish Snowbeds." He pointed out that in consequence of the critical level of the mean winter temperature there was a greater difference between the snowfall of the hills and that of the plains in the British Isles than in neighboring continental countries. The altitude of 500 feet (180 meters) above sea

level is critical in the snowfall of Britain, severe drifting storms tending to become frequent above this altitude. About half of the area of England and Ireland and three-quarters of the area of Scotland and Wales are at more than 500 feet, and there is far more snow in these islands than Londoners commonly realize. Even in the south of England, on Dartmoor and Exmoor, great snowdrifts following exceptional storms have been known to last till midsummer. In the higher mountain ranges of Snowdon and the Lake District late-lingering snowdrifts are usual phenomena; but in the Grampian Hills of the Scottish Highlands, near the limit of perpetual snow, there are various late-lingering, semipermanent, or even permanent snow beds, which suggest several problems for investigation.

In "Notes on the Snowfall in Northern England" Gordon Manley pointed out that the frequent snowstorms in northeastern England combined with the fact that a large part of the population live at a high altitude leads to numerous problems that might profitably be studied by a close network of observers, such as heads of village schools. For example, a map of the depth of the snow in northern Yorkshire in February, 1933, would have enabled estimates to be made of the effect of drifting off hills, of convergence of air currents, and of the effect of the passage of air over snow uplands; in addition, further elucidation of the behavior of depressions moving in polar-air currents might have followed. The small size of the region would have facilitated investigation. Snowfall in England is a "marginal" phenomenon, whose variations may in turn have an appreciable effect on winter temperatures.

Robert Moss described "The Firn Structure of the North-East Land Ice Cap" as observed at the central icecap station (80° 5′ N.) of the Oxford University Arctic Expedition 1935–1936. By making use of a crevasse, investigations were carried to a depth of 70 feet. Pits dug at intervals in the upper layers of the firn revealed a laminar structure of more or less homogeneous layers of snow alternating with thin ice crusts, which had probably been produced by wind action when they were at the surface. During the spring there was a layer of well formed crystals at a depth of about one meter, which differed from the neighboring firn, at that depth also crystallized, in that they were not cemented together—in fact, many of them were so loose that when the pit was dug they ran out like grains of corn. It seems that infiltration of thaw-water into this layer causes the growth of the characteristic "blue bands" of ice found in the lower parts.

The program of the April meeting included a paper by N. E. Odell on "Ice and Snow: Their Erosional Effects, with Particular Reference to East Greenland" and a discussion on "the problems affecting the drifting of snow, and on the inauguration of a system of observers to measure snow depths in the British Isles."

J. E. CHURCH

HISTORICAL GEOGRAPHY

The Development of American Cartography. Dr. Erwin Raisz observes in a recent paper that "American geographers and cartographers are but little aware of the work of their predecessors" and that, whatever the reasons may be, this is certainly not because the earlier activities of Americans in the fields of geography and cartography were negligible (Outline of the History of American Cartography, *Isis*, Vol. 26, 1937, pp. 373–391). As Dr. Raisz aims to summarize in a few pages the development of cartographic production in the colonies and the United States, he can mention only the outstanding events. His paper, which is accompanied by a useful chronological table, may well serve to whet the reader's appetite for a more comprehensive treatment of the subject. "The first map compiled, drawn, engraved, printed, and published in America [i.e. what is now the United States] seems to be one of New England made by John Foster, the first Boston printer, in 1677. It is a crude woodcut, drawn with charming naivete, but even in its crudeness it must have represented,

in its time, a brave attempt in the finer arts amidst the harsh life of the early colonists." The "golden age of American cartography" is placed between 1820 and 1840. "During the two years from 1822 to 1824, not less than seven large atlases were published in the United States, and some of them were republished every few years." Although not particularly distinguished as regards cartographic technique, the county atlases that appeared in great numbers during the last half of the nineteenth century (the firm of G. A. Ogle, Chicago, produced no fewer than 700) constitute historical records of value to modern geographers in reconstructing earlier patterns of settlement (see, for example, H. F. Wilson: The Roads of Windsor, *Geogr. Rev.*, Vol. 21, 1931, pp. 379–397; and E. N. Torbert: The Evolution of Land Utilization in Lebanon, New Hampshire, *ibid.*, Vol. 25, 1935, pp. 209–230).

Pegolotti's Merchants' Handbook. Pegolotti was an employee of the Florentine banking house of the Bardi, a concern that had branches and agents in many of the cities of Europe and the Near East during the early fourteenth century. His "Book of Descriptions of Countries and of Measures of Merchandise" (to which the better-known title, "La practica della mercatura," was given by Pagnini, its eighteenth-century editor) is described by C. R. Beazley as a "merchant's handbook pure and simple; it is no literary composition; it deals in nothing of non-commercial interest; but it was of supreme value to traders of the fourteenth century; and to all students of mediaeval life, mediaeval travel, and mediaeval traffic, it is beyond price" (The Dawn of Modern Geography, Vol. 3, Oxford, 1906, p. 324). For this reason a new edition of the complete text, the first since that of Pagnini, is welcome (Francesco Balducci Pegolotti: La practica della mercatura, edited by Allan Evans, *Mediaeval Acad. of America Publ. No. 24*, Cambridge, Mass., 1936).

From the geographical point of view the two most interesting passages are those (1) in which the trade route from the mouth of the Don through Russia and Central Asia to Cathay is described and (2) in which a list is given of the stations and tolls along the route from Ayas on the Gulf of Iskanderun to Tabriz. Pegolotti himself certainly did not follow the first of these routes, for he states definitely that his account of it is based upon reports gathered from merchants. Beazley and, apparently, Sir Henry Yule, who includes translations of the two passages in his "Cathay and the Way Thither" (new ed. by Henri Cordier, Vol. 3, *Hakluyt Soc. Publs.*, Ser. 2, Vol. 37, London, 1914, pp. 135–173), held that Pegolotti made the journey to Tabriz; but Dr. Evans says there is no proof of this and is inclined to believe that most of the data concerning Asia were collected while Pegolotti was serving as the Bardi's agent in Cyprus. Evans' text is supplemented by a series of glossaries in which place names mentioned by Pegolotti are identified (these include an interesting list of religious houses in England) and explanations are given of the commodities, weights and measures, and coins to which he refers. According to Yule, "nothing is known of . . . Pegolotti, except what is gathered from his own book." Evans has dug up a good deal of information about him from the Florentine archives, which shows that he was not only "among the most valued and trusted executives of his great firm" but that he held high and responsible positions in the government of Florence.

GEOGRAPHICAL REVIEWS

Ancient Man in America

Albert Ernest Jenks. **Pleistocene Man in Minnesota: A Fossil Homo Sapiens.** With a Chapter on the Pleistocene Geology of the Prairie Lake Region, by George A. Thiel. xiii and 197 pp.; maps, diagrs., ills., bibliogr., index. The University of Minnesota Press, Minneapolis, 1936. $7.50. 12 x 9 inches.

The antiquity of man in North America is a question that has agitated two generations of scientists. Greatly heralded finds of artifacts or skeletons have been investigated and reinvestigated, advocated as authentic and condemned as frauds, cautiously accepted as significant and rejected as indeterminate. About ten years ago the general opinion of archeologists and anthropologists had crystallized into a doctrine from which there was only mild dissent: that man was a recent invader of this continent and passed over Bering Strait some 3000 years ago. In the Symposium on Early Man held last March in honor of the one hundred and twenty-fifth anniversary of the founding of the Academy of Natural Sciences of Philadelphia these views were earnestly supported; but the very fact that the symposium was held indicates a change of attitude, and the existence of cultures older than those recognized ten years ago is admitted.

The new orientation to the whole problem was brought about by the discovery near Folsom, N. Mex., of beautifully chipped points of peculiar shape associated with numerous skeletons of an extinct species of bison. The Folsom points have now been found over a wide area and with associated scrapers, gravers, and other tools represent a hunting people distinctly different from the familiar Amerindian (F. H. H. Roberts, Jr.: A Folsom Complex: Preliminary Report on Investigations at the Lindenmeier Site in Northern Colorado, *Smithsonian Misc. Colls.*, Vol. 94, No. 4, 1935; *idem:* New Developments in the Problem of the Folsom Complex, *Explorations and Field-Work of the Smithsonian Instn. in 1936* (*Publ. 3407*), 1937, pp. 69–74). The Folsom points and also the closely associated and perhaps younger Yuma have a pre-Neolithic aspect. They resemble in their execution the implements of the late-Paleolithic cultures of Europe. These or closely related cultures are known to extend eastward into Siberia as far as the Irkutsk region, where Petri (*Proc. 1st Internatl. Congr. of Prehistorical and Protohistorical Science*, London, 1932, pp. 87–88) has found laurel-leaf points and other objects associated with *Bos primigenius*. A horizon of somewhat earlier aspect occurs northwest of the city of Irkutsk, where the skeleton of a child was found (see E. A. Golomshtok: Trois gisements du paleolithique superior de Russe et Siberien, *L'Anthropologie*, Vol. 43, 1933, pp. 336–346).

Unfortunately no human bones have yet been found in any of the Folsom or Yuma sites, so that the physical characteristics of these peoples are unknown. The extinct animals associated with the Folsom culture do not afford critical evidence of geologic age. In the volume under review Professor Jenks makes a permanent record of an outstanding discovery of human remains, which can be dated geologically, though unfortunately they cannot be related directly with any of the cultures of admitted pre-Amerindian type.

On June 18, 1931, a road crew on Minnesota Highway 30 (U. S. 59) was cutting with a grader a V-shaped groove in the highway 2½ feet deep and 28 feet wide. In the smooth floor of this cut, which showed and even exaggerated the banding of the local varved clay silt, Carl Steffen, one of the crew, walking behind the grader, saw a bit of shell. As he had never before seen such a shell in this material, he stopped the grader, and scratching below the shell, which later proved to have been a primitive bangle, he found bones. The crew excavated the skull and most of the skeleton.

laid it to one side, and proceeded with the work. The resident engineer, following orders, telephoned to Professor Jenks. Professor Jenks records all the details pertaining to the discovery and his two supplementary excavations, during which he found fragments of the skeleton that had been overlooked. The authenticity of the find cannot be doubted. The testimony of the road crew that the banded silt was completely undisturbed above the skeleton is confirmed by the undisturbed condition seen in the sides of the road cut.

If the skeleton is admitted to be contemporaneous with the silt, what is the age of the silt? The silt belongs to a narrow band of silt and sand lying between the Altamont-Gary system of moraines and the Big Stone Moraine. As Leverett suggested some years ago and Thiel's study confirmed, the silt was deposited in a preglacial lake (glacial Lake Pelican) between the ice lobe that deposited the Big Stone Moraine and the hills of the older Altamont-Gary Moraine. The ice lobe that deposited the Big Stone Moraine lay in the basin of the Red River and by its retreat permitted Lake Agassiz to be formed. As Glacial Lake Pelican was in existence when the basin in which Lake Agassiz was later formed was still filled with an ice lobe, Lake Pelican must be older by many years. According to the course of glacial events as outlined by Leverett, Lake Pelican lies well within the period of glacial retreat, though by no means at its close. We have yet no agreement as to the significance of the commonly used European terms "late Glacial" and "post-Glacial"; but if we follow Antevs, Lake Pelican would fall in the late Glacial. According to his geochronology, the beginning of Lake Agassiz dates to a time 18,000 years ago. Lake Pelican and, therefore, Minnesota man are earlier, or roughly 20,000 years old. To such a date Antevs objects because he accepts (The Spread of Aboriginal Man to North America, *Geogr. Rev.*, Vol. 25, 1935, pp. 302–309) Johnston's theory that man entered North America in late-Glacial time in the corridor through the Great Plains between the Cordilleran and the Keewatin ice sheets. This corridor, according to present knowledge, was not open at the time the Big Stone Moraine was formed. Thus, if Minnesota man is contemporaneous with Lake Pelican, the weight of the evidence would indicate that man entered the continent in pre-Wisconsin time or in the third interglacial. It would be premature to advocate so great an antiquity for man in America, but if it was so, many present difficulties could be reconciled. If the basic stock had reached the two American continents in the third interglacial, the stress of changing climates during the Wisconsin would have given the present uniformity of physical aspect and would have allowed time for the domestication of cultivated plants, particularly the outstanding achievement of the development of the many cultivated varieties of maize, which to the reviewer have always seemed strong arguments for the antiquity of man in America.

The greater part of Professor Jenks's book is devoted to an analysis of the skeleton. He has proved that it belonged to a young girl fifteen years old. Unfortunately racial characters are not well marked in fifteen-year-old girls, nor have many such youthful skeletons been subjected to searching analysis. Professor Jenks has painstakingly searched for each primitive character, but to one not a physical anthropologist the outstanding character is the size of the teeth. This young girl had teeth of a size hitherto unrecorded and approached only by the Neanderthal men of Europe, who were, in other characteristics, more unlike modern man. The teeth become the main evidence that Minnesota man differed physically from the Amerindian. It is natural that the primitive characters of Pleistocene man of Europe should be sought for; but there is no compelling reason for believing that men of the same antiquity on this continent should be equally primitive. Modern man originated before he was dispersed throughout the world. It may be that the route from the center of evolution to North America was shorter and happened to be open at such a time as to receive the first migrants.

With the skeleton were found two shell bangles and a bone knife. These artifacts

are such as might be associated with an Eskimo-like culture suitable to people living near the ice front in the glacial retreat. They do not afford a correlation with any established culture. However, another find by Professor Jenks, as yet inadequately reported (A. E. Jenks: The Discovery of an Ancient Minnesota Maker of Yuma and Folsom Flints, *Science*, Vol. 80 (N.S.), 1934, p. 205), gives a clue to the cultural sequence. In gravels deposited by the outlet stream of Lake Agassiz a buried skeleton known as Browns Valley man has been found. With this skeleton six laurel-leaf points were associated. The workmanship is similar to that of the Folsom and Yuma points, but the reviewer considers that the type is distinct. The points and skeleton apparently represent another pre-Amerindian culture, but it is distinctly later than Minnesota man. The skeleton is that of a mature man, longheaded and with prominent brow ridges. The physical type is that of modern man but is apparently not closely related to that of the local Indians. This find may indicate that in Minnesota, and perhaps generally, the cultures characterized by laurel-leaf points of generalized or specialized types are later than a still uncharacterized culture, of which the Lake Pelican skeleton gives us some idea of the physical type.

Professor Jenks holds that the ideal area in which to solve the problems of the antiquity of man on this continent lies in the Middle West, with its well studied glacial chronology. His success justifies this belief, and study of important geologically dated skeletons tends to prove the thesis and has made Minnesota an outstanding field for such research. The beautifully printed monograph here reviewed sets a standard in completeness and in typography for the publication of such important contributions to the antiquity of man.

KIRK BRYAN

HISTORY OF AMERICAN AGRICULTURE

JOSEPH SCHAFER. **The Social History of American Agriculture.** viii and 302 pp.; maps, index. The Macmillan Company, New York, 1936. $2.50. 8 x 5½ inches.

HAROLD FISHER WILSON. **The Hill Country of Northern New England: Its Social and Economic History 1790–1930.** xiv and 455 pp.; maps, ills., bibliogr., index. Columbia University Press, New York, 1936. $4.25. 9 x 6 inches.

Dr. Schafer has brought together his recent University of London lectures, here presented in eight chapters supplied with topic headings and otherwise modified to render the material more suitable for the classroom. The book contains many refreshing interpretations of familiar themes and occasionally breaks new ground for the student of social problems. Several of the chapters are of interest to the instructor of economic or historical geography who seeks to assign material in authentic sources but finds the usual treatments altogether too exhaustive or statistical.

In "Land for Farmers" the author draws a broad picture of public land problems and policies, especially the antecedents of the homestead act, and successfully defends his thesis that in a country apparently oversupplied with farm land one of the most persistent problems has been "making land available for ever-growing numbers." In "Primitive Subsistence Farming" much space is devoted to Indian clearings and crops in relation to early colonial settlements and husbandry, especially in New England—a significant topic which has heretofore been largely neglected in literature of the survey type. In Virginia and southward along the coast, subsistence farming was soon overshadowed but not displaced by commercial agriculture, a topic more fully treated in Chapter 3: "Big Business Farming." In this chapter also the author follows wheat raising from east to west and similarly traces stock ranching from its early piedmont setting to its culmination in the Great Plains. Witnessing the later spread of sheep raising the author ventures the prophecy that

"the day of the cattleman is about over, whatever fate may be in store for the natural pasture lands of the West." Two other chapters treating of social and political trends in rural life are of interest. Here the author exposes the myth of the southern planter aristocracy and describes the influence of the planter group on early political policy. Political repercussions of advancing westward settlement are also discussed. These chapters are supported with maps from the "Atlas of the Historical Geography of the United States" published by the Carnegie Institution of Washington and the American Geographical Society (1932).

Throughout, westward settlement is handled in the best Turner tradition, though it would seem possible to make the discussion considerably more quantitative now that data and maps of internal migration are available. Occasional passages such as "the Piedmont in Virginia was settled early and largely from the tidewater and middle sections" (p. 59) and "the enormous spread of the great plains, or the submarginal grassy upland of the far West, extending into and across the Rocky Mountains . . ." (p. 99) appear vague to the reader, especially so by contrast with the clear-cut style largely maintained. Numerous quotations from diaries and contemporary records of travel lend reality to the discussions of early environmental conditions. Considering its purposes, the book is adequately documented, the citations representing a selection of the extensive literature which Dr. Schafer has consulted.

Dr. Wilson's book, the third in a series of Columbia University studies in the history of American agriculture, is concerned with parts of three northern New England states, with emphasis on Vermont. The object has been to investigate "the life of the New England hill-country farmer and his family"—not "of those who fared forth from New England to the new lands of the West," but "of those who stayed at home."

Northern New England's agricultural history is subdivided into four periods (see Dr. Wilson's article, "Population Trends in Northwestern New England, 1790–1930, *Geogr. Rev.*, Vol. 24, 1934, pp. 272–277), suggesting an analogy to the seasonal rhythm. The study opens with "Summer" (1790–1830), during which "most sections . . . were blessed with the vigor of youth," followed by "Autumn" (1830–1870) "when the rural regions first reached and then passed the zenith of their development." "Winter" embraces three decades of farm abandonment lasting until 1900, followed by the rejuvenation of "Spring" without, however, "the promise of great growth such as the region had experienced a century earlier." Spring, in the opinion of the author, was initiated and sustained more by institutional activities than by spontaneous development of regional assets, hence the emphasis on the programs of state boards of agriculture, extension services, old home weeks, and the Grange.

In each of these periods state-wide readjustments in economic life are emphasized, with attendant population shifts and the factors responsible therefor—basic movements whose general nature and whose impact upon New England have so long been recognized as to have rendered them almost commonplace. Earlier findings are largely confirmed and further evidence contributed from contemporary writings, maps, and statistics for a significant part of New England. The many quotations from earlier literature, selected from a great variety of sources, shows how thoughtful people viewed these readjustments as they were taking place and groped at possible methods of stemming the tide of emigration. The various factors are arranged in chronological sequence, and the relative importance of each is evaluated in a clear, direct style.

The concluding chapter, "The Hill Country in Retrospect," investigates in part the question of "how the region itself fared during these years" (1900–1930) in which farm abandonment is seen as a "continuation of the movement begun in the previous century." The posing of this question here and elsewhere in the book reveals as its

objective (also hinted at in the title) a study not merely of agricultural history but also of regional geography. The geographer must insist, however, that northern New England, far from being *a* region, is a composite of many regions. Any kind of regional study that neglects these basic studies and overlooks such contrasts as exist, for example, between the Champlain lowland and the eastern upland must make a heavy sacrifice of reality in order to gain the advantage of greater ease in the use of statistical material. It is consequently not surprising that the book is unsuccessful in adding much to our knowledge of "how the region fared." Obviously little can be said which will apply to all of Vermont and New Hampshire and Maine. In the absence of a regional outline dependence is placed on towns and groups of towns for the necessary localization of material from which the reader may, with the aid of a township map and the data and population maps supplied, be able to make a partial regional synthesis of trends in population and farm abandonment. Landscape changes related to these trends and to local urban and town growth, not discussed as being possibly outside the scope of the book, are touched upon in a brief description of the varying fates of nine farms near Bethel, Vt., and a résumé of some regional studies, including the author's valuable contribution, "The Roads of Windsor" (*Geogr. Rev.*, Vol. 21, 1931, pp. 379–397). Abundant literature proclaims that what may be said in general terms regarding the "hill country" of northern New England applies with equal force to the uplands of Massachusetts and Connecticut.

RALPH H. BROWN

THE ST. LAWRENCE DEEP WATERWAY

C. P. WRIGHT. **The St. Lawrence Deep Waterway: A Canadian Appraisal.** xxi and 450 pp.; maps, bibliogr., index. The Macmillan Co. of Canada Limited, Toronto, 1935. $4.50. 8½ x 6 inches.

Although this excellent study is written primarily from the Canadian point of view, it should prove almost equally valuable to students of the project in the United States. As long as this project remains under discussion, this careful study will be timely; if and when the project is definitely accepted or rejected, it will remain a valuable historical reference.

In contrast with almost all other students of the projected waterway, the author modestly refrains from any final conclusion for or against. Rather, after a most thorough study of all available reports, he finds that the evidence is not yet sufficient to warrant any final conclusion. His most important single conclusion is not less valuable because negative: although the engineering aspects have been thoroughly and authoritatively reported on many times, "the economic prospects . . . appear to have received no such scientific and repeated consideration as this; . . . the record . . . shows that neither government . . . was ever possessed of any complete and impartial answer to the two fundamental and vital questions,—What benefits will these projected works afford? Will these immense expenditures really *pay*?" This statement is substantiated by a detailed history of the project, a carefully documented study occupying two-thirds of the book. This study traces the work of the many private, semipublic, and governmental agencies interested in the project, through the signing of the treaty between the United States and Canada in 1932 to its rejection by the United States Senate in 1934. Scattered through this discussion are critical analyses of the various governmental reports and many private reports, including several Canadian studies, as well as the better-known studies by the Brookings Institution and the earlier study of MacElwee and Ritter (on the study of MacElwee and Ritter see pp. 40–47). A long chapter is devoted to the "Beauharnois Concession," which the Canadian government granted to private interests in 1929, for the development of power in the Soulanges section.

The second principal part of the book takes up the economic aspects of the waterway. The problem of appropriate depth is discussed in great detail. The author not only agrees with the finding of Moulton, Morgan, and Lee of the Brookings Institution that the projected depth of 27 feet, as well as the future maximum of 30 feet, is too shallow to accommodate the ocean shipping anticipated, but he goes beyond their recommendation of 33 feet and urges at least 35 feet, if not more, over the lock sills. In his calculations he states that an over-depth of one to two feet greater than the draft of vessels is necessary in rock or boulder-filled sections—a critical factor ignored in some official reports.

The study of the possible benefits to Canada is of particular importance. The analysis of various studies of the effect on the grain trade concludes that the deep waterway should result in a lowering of the cost of shipping grain from the upper lakes to Montreal by only 2 cents a bushel, whether by ocean steamer or by lake freighter. In criticism of various optimistic predictions regarding the use of the deep waterway for package freight it is pointed out that, although present all-water rates offer a saving of at least $1.11 on a ton of flour, practically all Canadian flour is moved by the more expensive lake-and-rail route via Georgian Bay or Lake Huron ports.

Many reports have assumed that all savings in transportation costs would accrue to the people of the United States and Canada, but the author asserts that, in the case of Canada at least, probably more than half of the savings would go to foreign consumers as lower prices. Another aspect that is considered especially from the Canadian point of view would also be of concern to Duluth. Ocean steamers entering the lakes would bring in cargoes chiefly for American ports on Lakes Erie and Michigan and would therefore offer lower return rates from those ports than from the Lake Superior ports. (At present rates are about the same from Lake Michigan and Lake Superior.)

Various Canadian reports have urged the construction of the enlarged system if only because the present St. Lawrence canals will soon be overtaxed; but this argument is dismissed with the conclusion that these canals could, with only slight improvement, handle even the traffic that optimists expect the deep waterway itself will attract. Finally the author notes that since the earlier reports on projected traffic were prepared two alternative routes have become of importance, draining traffic away from the lake system entirely. The more important is the route through Vancouver, which since the readjustment of rail rates in 1927 has become of chief importance in the shipment of Canadian grain to Europe. Presumably less important is the newly developed Hudson Bay route, which now handles only 5 million bushels but which, he thinks, might handle as much as 25 million.

In his final section the author finds certain critical shortcomings in the treaty signed by the two governments in 1932. Although this treaty was not ratified by the United States Senate in 1934, it is expected to be presented again in the near future, so that these criticisms are of special importance. The treaty, by fixing the depth of the lock sills, will determine the maximum depth of the waterway for the indefinite future. In the light of this fact the author finds that the question has not been given enough consideration. The depth should be determined in relation to depths downstream from the canals rather than upstream. As Montreal now has a 35-foot channel to the sea and is considering deepening that to 40 feet, the author fears the depth fixed by the treaty may prove much too shallow.

Various clauses in the treaty will necessitate international coöperation more or less continuously, but there is no provision in the treaty to take care of this. Thus, if it is found desirable to deepen the entire waterway from 27 feet to the maximum of 30 feet permitted by the locks, it will be necessary to go once more through the long and difficult business of getting a treaty signed and ratified on both sides. The treaty provides that an equal amount of water shall be diverted for power on each

side of the international-rapids section and that the flow of water from Lake Ontario shall be controlled, but it does not set up any permanent commission to handle this. The author urges that two international commissions be set up, one for the Welland Canal and St. Lawrence River sections and one for the lakes above the Welland Canal. Finally, he thinks that it may be necessary, from the Canadian point of view, to impose tolls on shipping to pay the cost of the waterway. For political reasons Canada did not wish the United States to pay for the construction of works in Canada and therefore was forced to accept a share of the cost disproportionate to both her present resources and her future interests in the waterway. These tolls would be administered by the same commissions.

RICHARD HARTSHORNE

LAND SETTLEMENT IN SOUTHERN ONTARIO

CARL SCHOTT. **Landnahme und Kolonisation in Canada am Beispiel Südontarios.** xv and 330 pp.; maps, diagrs., ills., bibliogr. *Schriften Geogr. Instituts der Univ. Kiel*, Vol. 6, 1936. RM. 12.

Dr. Schott's book deals with the southern part of the province of Ontario, a region bounded by the Great Lakes, the Ottawa River, and Lake Nipissing.

Of the 300 pages that make up the text of this interesting book, the first 15 deal with the geological structure and climate of the region and another 20 with a reconstruction of its physical appearance in about the year 1800. Two very brief chapters follow, on the Indian and French occupation of Ontario, which lead naturally to the central, and by far the most detailed, section, the period of British colonization. Nearly one-third of the book is devoted to a detailed consideration of the methods of land division and land distribution in the early years of the British regime. Another third describes the early agrarian economy of the region and traces the development of its trade, transportation, and growing urban centers up to the middle of the nineteenth century. The last, and much shorter, section sketches the final transformation of Ontario from frontier colony to modern, industrialized province. The book is well supplied with maps and concludes with an admirably arranged bibliography and a selection of carefully chosen and excellently reproduced photographs.

In considering the aim and value of the volume it should at once be made clear that this is essentially the work of a European, written for Europeans. This has led to the inclusion of much familiar material, but it has also enabled the author to handle his subject with a simplicity and freshness not always possible to the local observer. It has further led to the introduction of many interesting comparisons. The author is not simply interested in the historical geography of southern Ontario per se; he is also interested in showing how the experiences of the earliest settlers in Upper Canada may be used to throw light on the prehistoric settlement of northern Europe. He shows clearly that the Canadian analogy does not support the assumption that the forests of northern Europe proved an impassable barrier to primitive migration. He also demonstrates that, in Canada, forest regions, far from discouraging agriculture, furnished an immediate yield to even the crudest form of cultivation. Whether the arguments that Dr. Schott is able to offer from his study of Canadian conditions will be sufficient to rout the carefully elaborated theories of the German geographer Gradmann and his followers, we may leave to European reviewers to surmise.

Quite apart from the new light that the book throws on European problems, it offers a very valuable contribution to the historical geography of Ontario, a contribution even more striking because it is the first of its kind. Some of the subject matter of the book has been handled in a different way elsewhere; but nowhere before has the attempt been made to mark the actual manner and progress of the

change from virgin country to cultivated countryside. The section on the methods of land division and land distribution is particularly valuable. In Upper Canada the early land system was so closely associated with conflicting political doctrines and denominational disputes that its actual geographical consequences have often been overlooked. This scholarly analysis of the Ontario land system should therefore be welcomed by historians and geographers alike.

Perhaps the weakest aspect of the book is to be found in its organization. The author has attempted to describe the changing appearance of a vast tract of country over more than a hundred years by a simple division into two periods. Although perhaps justified by the author's greater interest in the period before 1850, this is the cause of considerable confusion. The absence of an index makes cross reference difficult, and at times it is almost impossible to discover to what date the author's observations apply. The development of the subject would have been clearer had the author either increased the number of his chronological divisions or confined his observations to a more rigidly chronological order.

In a book that treats of so wide a field errors have crept in, as in the brief chapter on place names and in the author's choice and use of statistical material. But although some of its findings may eventually have to give way to the results of more specialized investigations, the book should long remain the standard historical geography of the province of Ontario.

ELISABETH SIMS

KOREA: THE LAND AND ITS WORKING

HOON K. LEE. **Land Utilization and Rural Economy in Korea.** xii and 302 pp.; maps, diagrs., index. The University of Chicago Press, Chicago, 1936. $3.00. 9 x 6½ inches.

Dr. Hoon K. Lee of the Union Christian College of Korea, Pyengyang, undertook this survey of his native land at the request of the Institute of Pacific Relations. Aid in planning was given by the American Geographical Society, which also sponsored Dr. Lee's study of pioneer settlement in Manchuria (cf. "Korean Migrants in Manchuria," *Geogr. Rev.*, Vol. 22, 1932, pp. 196–204). The work was done on the "sampling system," with the assistance of 41 field helpers. The results are largely presented in tabular form: among the 132 tables is a remarkably comprehensive one of land utilization (1930) by provinces. The survey begins with a chapter on general conditions, which is followed by a description of agricultural characteristics. Acreage and yield of the chief crops are given and their distributions shown on dot maps, and there is a map of crop limits (a key map for locations would be helpful). A prime distinction is made between north and south—the north with wheat and beans, larger fields, and a single-crop system; the south with rice and barley, smaller fields, and double or multiple cropping. The cropping system is measured by Dr. Lee as "frequency of land utilization"—"the degree of intensivity of land use by planting crops one after another in a given year." For all Korea it is 134 per cent: paddy fields, 128 per cent; dry fields, 139 per cent. Note may also be made of the measure of the "annual damage inflicted on land and crops by the forces of nature," of which a careful government record is kept. In the period for which figures are given, 1926–1931, wind caused the greatest havoc.

An important section of the chapter on land utilization deals with the government's land-amelioration project, which is "not only a plan for better utilization of land, but a key to the solution of the food problem in Japan." The "more rice" project begun on a large scale in 1926 aims at the reclamation or improvement in a space of 12 years of 8½ million acres of land and the addition of 40,000,000 bushels to the rice output. Irrigation was a necessary accompaniment of the program, and irrigation companies, which received government aid, "sprang up like mushrooms."

Generally poor management, the depression, and the unprecedented fall of the price of rice put a damper on the plan.

Landownership and tenancy problems in Korea are colored by their racial and national aspects. Since the annexation Korea has proved a profitable investment colony for Japanese capitalists. Complete figures are not available, but the number of Japanese owners of large properties has increased greatly, whereas that of the Koreans has diminished.

Under the head of utilization of forest land interesting reference is made to early efforts at conservation (1789–1803). "In order to conserve the forest land, county magistrates were authorized to forbid any breaking of land for cultivation on the upper half of a hill." Unfortunately these wise measures fell into disregard, and the forests suffered heavily in the latter part of the last century. The government here has an important task before it; for the potential forest resources of Korea are great, and more than 70 per cent of the area of the country is classified as forest land. Korea is also rich in mineral resources, which are largely undeveloped, though even now she is the leading world producer of graphite.

Labor, rural credit, marketing, and standards of living are other matters discussed. The low standard of living of the Korean farmer has been still further depressed, as the "rice barometer" indicates. The per capita consumption of rice, the preferred food, was 0.744 koku (about 3.16 bushels) in 1912; in 1930 it was 0.459, or a reduction by one-third (in Japan it was 1.068 koku in 1912 and 1.138 in 1928). The final chapter, on agricultural colonization, describes the activities of two large-scale Japanese colonization companies operating in Korea.

Dr. Lee's valuable survey is noteworthy for the frankness and readability of its presentation.

Historical Geography of China

Albert Herrmann. **Historical and Commercial Atlas of China.** 112 pp.; maps, bibliogr., index. *Harvard-Yenching Inst. Monograph Ser.*, Vol. I. Harvard University Press, Cambridge, Mass., 1935. $5.00. 13 x 7¾ inches.

In this new atlas of China Dr. Herrmann, professor of historical geography at the University of Berlin, has produced a most useful little work. Not only is it attractive in appearance and convenient in arrangement, but it gives evidence on every page of painstaking research among the original sources. It does credit alike to the compiler and to the Harvard-Yenching Institute.

The atlas contains 40 single pages and 21 double pages of well executed maps. In general it employs the Wade system—the one most widely used among English-speaking peoples—in the transliteration of Chinese words. The frequent insertion, beside the corresponding place names, of the dates of important events is a commendable practice. The inclusion, at the back, of the Chinese characters for place names is an excellent feature, greatly increasing the usefulness of the book.

The map of Chinese prehistoric sites (p. 8) shows close acquaintance with the results of the latest researches. "Prehistoric" is not quite the correct term, however; for some of the places marked belong to the full historical period: "archeological" would have been a better word. On the same map some of the red arrows indicating the direction of early immigrations are introduced on what seems hardly sufficient evidence.

To indicate (p. 9) the "original principality" and the "later acquisitions" of the Hsia dynasty seems beside the point; for we have no conclusive evidence yet, either historical or archeological, of even the existence of such a line of rulers. The delineation, on the same page, of the extent of territory tributary to the priest-kings of the Shang dynasty is correct so far as our present knowledge goes.

The title of the map on page 13 would seem to imply that the Chou dynasty existed only from the eleventh through the ninth century before Christ. In reality

it endured until 255 B.C., through the periods covered by the next two maps. These two maps, incidentally, will be helpful to those trying to trace the history of an epoch highly complex and disturbed itself yet second to none in determining the character of the historical Chinese civilization. Commendation is likewise due the next two maps (p. 17), devoted to the obscure fortunes of the Hsiung-nu (almost certainly the forebears of the Huns of European history) during the last two centuries before Christ. The map on pages 18–19 shows the extent, during the latter half of the third century before Christ, of the dominions of Ch'in Shih Huang Ti, the founder of the first Chinese empire. His conquests, some believe, were pushed farther to the southwest than is here indicated; in reality the available evidence is inconclusive either way.

The Chinese penetration of Central Asia just before and just after the beginning of the Christian era (p. 24) is well indicated. On pages 30–31 the power ruling over southern China during much of the fifth century of our era is called the "Southern Sung": this should be "Liu Sung"; the Southern Sung dynasty did not come into being until several hundred years later, in 1127 A.D. Nara did not remain the capital of Japan until 794 A.D., as stated on page 39, but was removed to Nagaoka in 784.

The map on page 36 is of interest as showing the concentration of cities and towns in northern China as late as the sixth century of our era. It thus illustrates the failure of the Chinese urban civilization to penetrate up to that time very far south of the Yangtze River except along the coast and the principal inland trade routes. Pages 50–51 bring vividly home to us the vastness of the conquests of Genghis Khan and his immediate successors, who built up the greatest, though one of the most ephemeral, of continuous land empires that the world has ever seen. The same map also shows the routes followed by the Mongol hordes and by various medieval European travelers, among them Marco Polo.

The contrast in size between the territories ruled by the Mings, the last native Chinese dynasty (pp. 54–55), and those governed by the conquering Manchus (pp. 58–59) is striking and shows the impropriety of regarding the Manchu dominions as in any sense a "Chinese" empire. It is a fact often misunderstood in the Occident that subject peoples like the Mongols, the eastern Turks, and the Tibetans acknowledged allegiance to the Manchu emperors but never thought of themselves as in the slightest degree "belonging" to China. A firm grasp of this distinction is fundamental and essential to a right understanding of the course of present-day events in the Far East.

The ethnic and linguistic map (pp. 66–67) calls for little but praise; it shows exceedingly well the multiplicity of peoples, languages, and dialects found in the former dominions of the Manchu emperors. It may be noted that the investigations of Pelliot, Laufer, and others seem to have shown that the speech of the Lolo and kindred peoples of northwestern China forms not a distinct linguistic group of its own, as here suggested, but one of the subdivisions of the great Tibeto-Burman family of tongues.

The double-page maps scattered through the atlas that depict Eurasia during various periods perform a genuine service in showing the geographical position of China in relation to other regions and thus aiding us to obtain a proper perspective.

For its treatment of economic matters no less than for its elucidation of China's historical development, Dr. Herrmann's atlas merits high commendation. The maps (pp. 78–79) showing the distribution of Chinese domestic animals and cultivated plants and those (pp. 80–81) showing mineral resources and industries are full of interest and deserve far fuller discussion than can be devoted to them here.

The last map in the volume (p. 84), showing the distribution of the Chinese overseas, raises many questions, among them some bearing on that diffusion of the Mongoloid race that began in remote prehistoric times and is still going on.

There are some minor slips, certain of which, having to do with matters of capitali-

zation, vocabulary, idiom, and even spelling, betray the foreign origin of the work, but they do not lessen in the slightest the value of Dr. Herrmann's new atlas. It is excellent both in conception and in execution. Its usefulness, great as it is, will be much increased by the publication that is promised of a "Handbook of China" wherein are to be discussed the maps appearing in the atlas.

C. W. Bishop

Southwestern Chinese Borderlands

J. Siguret, transl. **Territoires et populations des confins du Yunnan.** x and 307 pp.; maps, bibliogr., indexes. Henri Vetch, Peiping, 1937. $4.50. 10 x 7 inches.

J. Siguret, of the French School of Living Oriental Languages, has translated from the Chinese six descriptive monographs written by Chinese Nationalists and published under the sponsorship of the military governor of Yunnan Province. All these monographs describe the peoples of southwestern China (chiefly Yunnan Province) as regards the relation of these groups to the question of the location of the boundary between China and British Burma (and incidentally relations between China and Siam and French Indochina). Relations between the Chinese and the Tibetan tribesmen west of China also enter the discussion. The justification that the Chinese give to the document is that they have lost territory on all exposed frontiers on account of the former governments' inattention to the border peoples. To help prevent what they call further encroachments, this study of bordering "barbarians" was made.

The peoples in Yunnan Province seem to be a mixture of Shans (mountaineers), more recent Tibetan tribes, and Chinese. Of the three basic groups in Yunnan, the Shans, who probably formed the stock out of which the Siamese, the Burmese, and probably the Khmers and other Malay peoples of southeastern Asia developed, are most interesting to the reviewer. The Shans in Yunnan have a long history, filled with constant warfare with the Chinese and the later Tibetans and among themselves. This volume recapitulates a part of this history and indicates, incidentally, how this constant pressure plus the desire for expansion has led to continuous migrations into southeastern Asia via the valleys of the Irrawaddy, the Salween, and the Mekong. Those who escape thus are the *Tai*, the free (in body; those who stay get their chief freedom either by constant fighting or by contemplation of the Buddha).

The studies start with Chungtien and other districts in the administrative region of Atuntze, on the Chinese, Tibetan, and Yunnan (district) borders, and cover systematically all the main peoples to the west, south, and east. The articles were formerly published separately in different reviews, so that there is some overlapping. Each study includes several topics about the people under discussion, such as location, language, numbers (if known), products, marriage, family, and birth customs. The studies are not uniform in scope, but nearly all of them deal systematically with four or five subjects: what brave fighters the people are; how they are armed; what they think of the Chinese; economic products; and, generally, something about sex and family life. The first four topics are easily explainable by the fact that these monographs (both in the Chinese and in translation) have military and nationalistic implications. The fifth topic arises out of natural Chinese contemplation of differences and similarities between the Chinese great family and the "small" free family system of the "barbarians."

The value of the work lies in its firsthand character and its naïve but clearly stated psychological bases. It is an excellent start for more careful studies. For the geographer or sociologist of primitive peoples in this region of Asia it makes a handbook for preliminary observations.

Carle C. Zimmerman

The Geography of Siam

WILHELM CREDNER. **Siam, das Land der Tai: Eine Landeskunde auf Grund eigener Reisen und Forschungen.** xvi and 422 pp.; maps, diagrs., ills., bibliogr., indexes. (Bibliothek länderkundlicher Handbücher.) J. Engelhorns Nachf., Stuttgart, 1935. RM. 30. 9 x 6½ inches.

The most exhaustive geographical work on Siam that has yet appeared is Credner's "Siam, das Land der Tai." The author made his field study from 1927 to 1929 and subsequently spent several years in organizing and coördinating his material.

The first three chapters describe the geology, climate, water resources, soil, and flora and fauna of the region. Successive chapters coördinate these earlier basic factors with the population and its social organization (*Lebensformen*), the agricultural and economic development (agriculture, fishing, forest use, minerals, industrial technique, and communication). The basic factors of the first chapters are also coördinated with the state and culture (political life, religion, learning, art, European relations, and relations to other countries in Asia) and with the development of markets and cities.

Five appendixes increase the usefulness of the book. Occidental readers will find the rules for spelling and pronouncing Siamese geographic names in Western languages to be helpful. Other pertinent data are average-rainfall statistics from 88 stations for 1914–1925, European equivalents for the standard Siamese weights and measures, the origin and transliteration of a few important Siamese technical terms, and an analysis of Siamese foreign trade for 1929. This section of the work is followed by a bibliography of 336 titles. In addition there are two indexes, 32 tables of statistics, 27 text figures, 12 maps, numerous photographs, and one long insert table, which gives some of the minor constituents of the Siamese population.

Unquestionably Credner has done a creditable piece of work. In general treatment this is the most authoritative book on Siam, and as a geographical monograph it is the best source now available. Readers may disagree with some of his analyses, but those who wish to learn what is known about Siamese geography will have to consult Credner's treatise.

I was particularly interested in the agriculture and the rural characteristics of Siam (see pp. 378–393 of this number of the *Geographical Review*). It was especially pleasing to note that in the sections on the material culture of the Tai he discusses and diagrams some of the village geographical forms (the relation between residence and land) for a number of types of sociogeographical organization. I have often thought that some of the statements about this matter by A. Demangeon and his school are too sweeping and all-embracing. One can see here in these *gemeinschaft* and relative *non-gesellschaft* types of villages that there is almost what one would call an innate tendency for the peasant to seek to draw his belongings about him as far as the exigencies of a simple irrigation system will permit. It seems to me that the agriculturist almost becomes a part of the soil. The water, mosquitoes, tigers, and snakes may force him near to other human habitations, but he is always (almost absent-mindedly) tying up his ferocious dog to the house entrance and wandering back to those fields that form as much a part of him as do his wife and children.

Credner's sections on agriculture are devoted primarily to description and correlation with geographical factors; nevertheless, he lays the basis for an understanding of the chief agricultural problem of Siam—that of a dry agriculture to supplement lowland rice culture and at the same time to furnish a food to replace fish as an animal protein source in the diet. Rice takes water, but the extension of rice culture into the swamps dries up the sources of fish as a food Siam is eventually, if not now, facing an important dietary problem—the lack of proteins and vitamins in the diet. This situation will have to be met by an extension of sea fishing, improved communication facilities, and the development of dry agriculture.

Like Credner, I am an admirer of the Siamese people; and it is my hope that his present study and further services in the same field will bring the country to a realization of its problems and their solution. In the past there have been many so-called "agriculturists" in Siam, but few of them have grasped, as Credner has, the main geographical factors in the agricultural and national life.

CARLE C. ZIMMERMAN

THE TONGKING DELTA AND THE ANNAMITE HOUSE

PIERRE GOUROU. **Les paysans du delta tonkinois: Étude de géographie humaine.** 666 pp.; maps, diagrs., ills., bibliogr., indexes. (Publs. de l'École Française d'Extrême-Orient, Vol. 27.) Les Éditions d'Art et d'Histoire, Paris, 1936. 200 fr. 11 x 7 inches.

PIERRE GOUROU. **Esquisse d'une étude de l'habitation annamite dans l'Annam septentrional et central du Thanh Hoá au Bình Định.** 82 pp.; maps, diagrs., ills., bibliogr. (Publs. de l'École Française d'Extrême-Orient, Vol. 28.) Les Éditions d'Art et d'Histoire, Paris, 1936. 60 fr. 11 x 7½ inches.

"Les paysans du delta tonkinois" is a fine piece of work in the tradition of the French school of regional geography—detailed, careful, informed with the spirit of the place, well documented, and exceptionally well illustrated. Four maps on a scale of 1 : 250,000 show relief (1, 2, and 3-meter contours), population density, distribution of villages, and names of villages; five other maps are on a scale of 1 : 500,000; there are 125 text maps and diagrams and 80 photographs, including remarkable aerial photographs by the Aeronautical Service of the Army.

The outstanding fact about the Tongking delta is its population: an area of 5800 square miles supports 6,500,000 people, or about 1120 to the square mile, almost entirely rural (the "towns" number only 350,000 people). In this respect and in the consequences that stem from it the delta differs from other alluvial plains of the Indo-Chinese peninsula: the lower Mekong, central Siam, and the Irrawaddy delta are far from saturated. Unlike these, Tongking exports little rice, and it counts its emigrants rather than its immigrants. It has also been more anciently populated, and its civilization reflects that of its Chinese neighbors. The delta is extraordinarily well marked off from the surrounding steep mountains: nowhere, says the author, could one find a greater discontinuity between regions, a discontinuity that expresses itself culturally as well as physically, even to the contrast in the color of the garments worn—the brown of the delta folk and the blue of the hillmen. Villages —there is no dispersed population,—house types, fishing, crafts are described in detail. Rice, of course, occupies first place in Tongking economy; but every farmer is also a fisherman, and there are some floating villages whose inhabitants spend their entire lives on the water.

M. Gourou has a keen feeling for the beauties of the delta. At first so monotonous seeming, it reveals nuances to the seeing eye and changes with the changing seasons. The landscape is one into which the human element is harmoniously fitted. Although the people are desperately poor, their poverty is neither unlovely nor hopeless; they have created a civilization in which they can find social and moral satisfaction. What, then, of the impingement of modern civilization? Probably little can be done to ameliorate their lot as long as population density remains where it is, and the utmost caution should be used in introducing elements of change lest the delicate balance of their ancient economy be upset.

The short monograph on the Annamite house is done with equal care. "Annamite houses," says the author, "make a fine subject for study, and one must not be misled by the impression of the casual traveler who sees under the mass of dun-colored roofs only misshapen huts hastily put together of haphazard materials. The

Annamite house, on the contrary, is a carefully designed structure, built with skill and according to precise rules that speak long experience and esthetic appreciation. The Annamite house, like the houses of other peoples of Indochina and Insulindia, is rich in its animistic content; it is built to the accompaniment of so many and such complex rites that it is as much a religious as a material work. The house has a place in the moral concepts and religious beliefs of such importance that it cannot be ignored by those who would penetrate to the bottom of this Annamite civilization that conceals its profound origins beneath a thick Chinese veneer."

Regional Studies from India

Shiba Prasad Chatterjee. **Le Plateau de Meghalaya (Garo-Khasi-Jaintia): Etude géographique d'une région naturelle de l'Inde.** 169 pp.; maps, diagrs., ills., bibliogr. Les Presses Modernes, Paris, 1936. 30 fr. 10 x 6¼ inches.

S. D. Pant. **The Social Economy of the Himalayans: Based on a Survey in the Kumaon Himalayas.** 264 pp.; maps, ills., bibliogr., index. George Allen & Unwin, London, 1935. $5.00. 8¼ x 5¼ inches.

"Meghalaya," which may be translated "The Rainy Country," is the author's own term for the detached fragment of the ancient massif of peninsular India that rises above the surrounding alluvium of the Indo-Gangetic lowland to form the Garo, Khasi, and Jaintia Hills of Assam. The need of a comprehensive title for this distinctive morphological unit was recognized long ago, and the one first employed by Medlicott, namely "The Shillong Plateau," passed into currency among members of the Indian Geological Survey, though, Dr. Chatterjee emphasizes, the name was applied more particularly to the eastern part of the area. It is felt, however, that less ambiguity attaches to the term "The Shillong Plateau" than Chatterjee suggests and while his title of "Meghalaya" may have the merit of connoting the dominant geographical characteristic of the Assam hill country, will it ever carry meaning to any but a few?

Brought to fruition under the guidance of Emmanuel de Martonne, "Le Plateau de Meghalaya" is devoted, for the most part, to an analysis of the physical evolution and geomorphology of that region. As such it will be appreciated by all serious students of geography, for it clarifies and amplifies knowledge of the physiography of an intensely interesting but still imperfectly known corner of India. Unfortunately the rest of the book, in which the author treats in turn of the climate, flora, fauna, and population of the region, falls below the standard of the earlier part. Allowance must be made for lack of data relating to the several aspects discussed, but it is hard to explain the doctrinaire technique of the author. Such statements as those on pages 109 and 134, which treat the distinguishing racial characteristics of certain of the inhabitants in terms of climate without attempting an argument in support of such a thesis or any mention of other possible factors, are unsatisfactory. One important misprint must be noted, namely *chaude* for *froide* (p. 92, line 19).

"The Social Economy of the Himalayans" treats of the part of the Himalayas that, lying between the Ganges and the Kali Rivers, is known generally as Kumaon; it includes, administratively, the Almora, Naini Tal, and Garhwal districts of the United Provinces. Himself a Kumaoni, the author's accounts both of life in the valleys and on the higher slopes of his Himalayan home are full of interest and rich in information that has been lacking hitherto or else not accessible to the ordinary reader. Every aspect of the varied schemes of rural economy obtaining throughout the area is described, and the part played by transhumance in Himalayan life is clearly and fully portrayed. "The Social Economy of the Himalayans" is a book that geographers will read with profit, but it is not the work of a trained geographer.

This is apparent from place to place throughout the text and, in particular, in the introductory chapter, "Physical Features and Natural Regions," which is reminiscent of a gazetteer account, informative but superficial, and leaves the reader without any clear picture of the area as a whole or of its parts. Nor are the author's maps those of a trained geographer, though his pictorial illustrations are excellent. The date of the preface (1932) explains the omission of the 1931 Census of India, Volume XVIII, The United Provinces; and one could note the absence of other authoritative sources from the author's list of references. On page 51 "April to November" should read "November to April," and "Roxley" appears for "Roxby" on page 85.

A. V. WILLIAMSON

RIFT VALLEYS

BAILEY WILLIS. **Studies in Comparative Seismology: East African Plateaus and Rift Valleys.** x and 358 pp.; maps, diagrs., ills., bibliogr., index. *Carnegie Instn. Publ. No. 470*, 1936.

This attractive volume, beautifully illustrated, gives the results of the author's extensive field studies in 1929–1930. The great rifts and associated features have become famous through the writings of Suess, Gregory, and other geologists; and the introductory chapter of the present volume properly reviews the varied structural interpretations that have been offered. Following chapters give, in order, a concise description of all major tectonic features in East Africa, with suggestions as to the nature of the regional stresses that produced them; an exploitation of the author's "asthenolith" hypothesis, in a frankly speculative attempt to explain all the major features as the result of a common cause; detailed descriptions of the chief units in the system of rift valleys, with interpretative suggestions; and discussions of volcanic phenomena, earthquakes, and gravity data in relation to the regional structure. A bibliography listing numerous works on rift valleys and related subjects surprisingly omits any mention of F. Dixey, an active proponent of the tension hypothesis of rift development. The volume is adequately indexed.

Careful study of this well written monograph, with its maps and illustrations, gives a unified picture of the wide rift country. Suggestions as to genetic development, with which the active mind of the author has filled even the descriptive chapters, will no doubt arouse a varied response. The reviewer sympathizes with the general concept that the principal tectonic event in East Africa was the uplift of the great plateaus and that the "rifts" reflect differential vertical stresses during the uplift. Interpretation of the fault pattern as either caused or modified by various horizontal stresses, as represented on the tectonic map (Pl. 3), is interesting but not convincing. Throughout the discussion there is a mingling of the inferential with the factual that many readers will find regrettable. Faults are labeled definitely as "upthrust," "overthrust," "underthrust," "normal upthrust," and "normal gravity" faults; and narrow ridges like Mt. Ubwari are referred to unreservedly as "upthrust" blocks, though there is admittedly no direct evidence of the downward-converging faults assumed by the author.

It is evident that the deep soil of equatorial Africa is a serious obstacle to determination of the bedrock structure. Surface forms speak eloquently of large vertical movements in late geologic time; but good rock outcrops are too scattered to permit confident conclusions regarding the nature of critical faults, at least in the present stage of investigation. Any attempt to present a regional genetic interpretation must draw heavily on speculation. Dr. Willis has brought together the results of recent surveys in that difficult region, and his ingenious synthesis is a valuable addition to the literature on rift valleys.

CHESTER R. LONGWELL

A Handbook of Czechoslovakian Agriculture

Eduard Reich. **Die tschechoslowakische Landwirtschaft: Ihre Grundlagen u. ihre Organisation.** 312 pp.; maps, diagrs., ill., bibliogr. *Berichte über Landwirtschaft*, Suppl. No. 108 (N.S.), 1935.

This monograph, with its 33 maps, 58 diagrams, and 190 tables, attempts to present the physical and cultural backgrounds, the organization and trend of Czechoslovakian agricultural production. It is a statistical handbook with textual interpretation rather than a regional study, and somewhat less geographic than the title would imply. The treatment begins with a rather inadequate discussion of the natural landscape, climate and natural vegetation receiving brief attention. The importance of altitude as a climatic factor is rightly emphasized, and the agricultural regions or zones are roughly defined: the sugar-beet region, at the lowest altitudes; the small-grain region, slightly higher; the grain-potato region, near the mountains; the forage-crop region, at the upper limit of cultivation. This zonation is frequently referred to, but it does not appear on the maps.

As a background to the central theme such topics as the size of farms, communication lines, artificial drainage, and the ratio of commodity prices are introduced. Another section deals with the human factor in agricultural production, the population density with respect to cropland, the migration to the industrial cities, and the farm-workers organizations.

Crop production is presented as percentage of total cropland. Grain and potato acreages have increased; forage crops and legumes have declined. Individual crop maps show that winter wheat is more important in the east and corn in the extreme east, whereas sugar beets and winter rye are more important in the west. The potato has a more even distribution. The numerous maps leave much to be desired. Lacking scale and poorly oriented, they show the distribution of crops by large political units only, and the agricultural regions are indicated merely by Roman numerals for each province.

The study of animal production follows much the same pattern. Distribution is indicated, however, in proportion to cropped land and thus demonstrates the relative importance of livestock in Bohemia and Slovakia, as compared with the east.

Finally the progress of Czechoslovakian agriculture since the World War is summarized with the aid of numerous diagrams for specific products and for the main cultural divisions. Much information is crammed into this volume, but one looks in vain for isopleth or dot maps and descriptions of specific regions.

Samuel N. Dicken

East Greenland Waters

Anton Jakhelin. **Oceanographic Investigations in East Greenland Waters in the Summers of 1930–1932.** 79 pp.; maps, diagrs., bibliogr. *Skrifter om Svalbard og Ishavet No. 67*, Oslo, 1936. Kr. 7. 10 x 7 inches.

This paper presents the results of the physical oceanographic work of the Norwegian expeditions to East Greenland in the *Polarbjørn* during three recent years. The author has compiled a bathymetric chart of the Greenland Sea adjacent to the coast of East Greenland between latitudes 72° and 75° N. The chart, based on soundings from various sources, shows isobaths at 100, 200, 300, 400, 600, 1000, and 2000 meters.

Systematic presentation and discussion of current velocities, salinity, oxygen content, and, in the fiords, sea-level determinations bring out some new facts and strengthen some earlier beliefs. The cold East Greenland Polar Current, including much meltwater, flows southward out of the Polar Sea. In the Greenland Sea it is underlain by Atlantic water, which, moving north and west past Norway and

Spitsbergen, has curved west and south along the south slope of the Nansen Ridge and has descended beneath the Polar water on account of its greater salinity and, therefore, greater specific gravity.

From observations made during two summers the translocation of water in the Polar Current is calculated to range from 1.3 to 1.6 million cubic meters a second, velocities being greatest along the relatively steep continental slope off East Greenland.

The salinity and the oxygen content of several fiords are shown to be related to the depths and bottom configuration of those fiords.

The continuation of thorough and systematic studies such as this should provide a solid factual basis for further work in the related marine flora and fauna and in climatic investigations.

RICHARD FOSTER FLINT

"LIEBEVOLLES EINGEHEN" IN CLIMATOLOGY

V. CONRAD. **Die klimatologischen Elemente und ihre Abhängigkeit von terrestrischen Einflüssen.** xii and 556 pp.; maps, diagrs., bibliogrs., index. (Handbuch der Klimatologie, edited by W. Köppen and R. Geiger, Vol. I, Part B.) Gebrüder Borntraeger, Berlin, 1936. 10½ x 7 inches.

The present decade has thus far been generous with German works in general climatology. Köppen's "Grundriss der Klimakunde"—a revision under happier economic auspices of his "Klimate der Erde" of 1923—appeared in 1931, and Karl Knoch's revision of the first volume of Hann's classic "Handbuch" in 1932. In 1936 the first volume of the Köppen-Geiger "Handbuch," devoted to general climatology, attained completion with the publication of a bulky fascicule occupied mainly by V. Conrad's treatise on the climatic elements and their distribution. When the six parts that make up this first volume of the Köppen-Geiger "Handbuch" are brought together, Conrad's contribution easily dominates. And appropriately dominates, since one who consults a large work on general climatology does so most frequently in search of the answer to some question concerning the dependence of a climatologic element on terrestrial influences.

The huge body of material incorporated into Conrad's work is arrayed in iron consistency with the wording of its title. After introductory sections on radiation and the composition of the air, the climatologic elements—temperature, wind, and the hydrometeors in succession—march inexorably through hundred after hundred of pages. Under each element methods of observation are touched upon and warnings uttered concerning sources of error. Methods of working up observations are described fully and critically. Then the distribution of the element, with respect to latitude, continentality, and relief of the land, and its variations through the daily and annual cycles are described and illustrated by the citation of abundant and critically selected observations. This general pattern is modified in accordance with the special requirements of each element, but every chapter is informed by the spirit of "loving detail" recommended by the author to regional climatographers.

This treatment does not make for as easy reading as does Hann's arrangement of similar material according to such large complexes as marine, continental, and mountain climates; especially if the exposition is carried by Hann's special talent for weaving text and numerical table into a fabric that does not oppress the reader. "I shall be gratified," remarks Conrad in his preface, "if the following pages are 'read'; but I should not wish to compel any one to 'read' them. Everything is arranged for reference." And as a reference work the form adopted leaves little to be desired. Analytic table of contents, systematic division of the text, citation in footnotes and sectional bibliographies of an overwhelming mass of literature, and a good index are all here.

Physical explanation of the phenomena thus clearly exhibited occupies a minor place. The mirror that Conrad holds up is not one that focuses the multitudinous facts of terrestrial climate to a brilliant physical interpretation, nor one that diffuses them into impressionistic description, nor an astigmatic surface that distorts their collective image according to some bias of the author's mind. It is instead a plane mirror, ground to as true a surface as possible. Empirical generalizations are more frequent than physical; the following one regarding the annual march of frequency of thunderstorms is a sample plucked at random: "In regions with many thunderstorms, summer maximum; where the phenomenon is rare, tendency toward a winter maximum." A writer having a penchant for physical interpretation would have first defined the regions having many and few thunderstorms with reference to the thermodynamic properties of the air in which they are produced, sketched the seasonal changes in these properties, and finally brought the seasonal changes in frequency of thunderstorms into correlation with seasonal changes in the properties of the air. In this reticence towards physical generalization one recognizes the powerful spell that Hann's example still lays on Austrian climatology. That example imposes humility and restraint, bids the climatologist laboriously sift and reduce to homogeneity in space and time the raw data of observation, and demands full and systematic exhibition of the refined data. It warns that over large parts of the earth the evidence is still scant and undependable. And it administers a salutary though tacit rebuke to those of us who are inclined towards unseemly haste in basing physical "explanations" on incomplete evidence.

JOHN LEIGHLY

CITY PLANNING

THOMAS ADAMS. **Outline of Town and City Planning: A Review of Past Efforts and Modern Aims.** 368 pp.; maps, diagrs., ills., bibliogr., index. Russell Sage Foundation, New York, 1935. $3.00. 9 x 6½ inches.

KATHERINE MCNAMARA. **Bibliography of Planning 1928–1935: A Supplement to Manual of Planning Information, 1928, by Theodora Kimball Hubbard and Katherine McNamara.** ix and 232 pp.; indexes. (Harvard City Planning Studies, Vol. 10.) Harvard University Press, Cambridge, 1936. $3.50. 10 x 7 inches.

According to its author, the "Outline of Town and City Planning" is written for two audiences: citizens interested in civic improvement and professional students of city planning; but Dr. Adams has done more than that, for he has produced a book useful to all students of urban areas and civic problems, geographers among others.

Cities have featured all periods of civilization, and Dr. Adams cites abundant evidence of city planning in all the periods. He traces developments in ancient times, in medieval Europe, during and after the Renaissance, and in modern times. In dealing with early planning in America, emphasis is laid on activities in New England towns. In some instances skillful engineers were hired to lay out towns according to specific objectives. William Penn, in his design for Philadelphia, provided the first comprehensive street plan for an American city. A street plan not well suited to the configuration of the land was developed for Manhattan Island as early as 1811. Charleston, S. C., Savannah, and New Orleans show evidences of early planning, and certain towns and cities of Virginia and the Carolinas contain fine examples of Renaissance architecture and town planning. A plan for Detroit was made as early as 1807 and another in 1831. The latter was a grandiose and formal plan only partially carried out.

Dr. Adams devotes the second part of his book to a survey of present-day phases of urban growth and city planning. He points out that in modern times the old military and social reasons for restricting the expansion of cities have disappeared

and that for economic reasons cities have expanded greatly. He deals with the causes of the growth of cities, emphasizing the importance of the use of power, the development of transportation, and the rapid evolution of technology. He shows also that political changes were associated with the technological changes and thus helped to give new direction and character to city growth. Dr. Adams concludes that government has become partly but not adequately adjusted to the greater dimensions and the complex forces of modern cities.

In the second half of his book Dr. Adams is concerned mainly with the growth and accomplishments of city planning in the United States. He covers rapidly the developments before 1900, recognizing the periods 1830 to 1840, 1840 to 1870, and 1870 to 1900. The modern city-planning movement apparently had its start in the last of these three periods. According to Dr. Adams, "the Chicago World's Fair of 1893" represented the culmination of more than twenty years' activity in the sanitary and esthetic improvement of cities, rather than, as is commonly thought, the beginning of a new period of planning effort.

After 1900 the percentage of our total population living in cities of 2500 or more increased rapidly. This growth of city population was accompanied by increasing interest in civic questions, and since 1909 city-planning conferences have been held annually. These and other efforts have done much to give effective guidance to city-planning activities. Simultaneously with these educational movements, state and municipal governments have shown increasing activity in extending their administrative machinery to promote and carry out city plans and civic improvements.

In tracing the beginnings of comprehensive planning Dr. Adams shows that city planning as a movement emerged from efforts along four individual lines: (1) the improvement of sanitation, housing, and park systems; (2) the creation of object lessons in town development; (3) the development of civic centers and other projects for civic adornment; and (4) the extension and improvement of means of communication. These four lines of effort still claim attention, but Dr. Adams finds increasing interest in treating them as subordinate elements in a master plan for the entire urban area. This belief in the importance of the master plan, rather than in any one aspect or phase of city planning, is to be expected of Dr. Adams in view of the fact that the technical staff of the Regional Plan of New York and Its Environs worked under his direction. The understanding of city-planning problems gained through leadership in that great survey is reflected in the present volume.

In a summary of the several aspects of city planning Dr. Adams recognizes the wisdom of collaboration in preparing surveys and plans. He mentions specifically the contributions of engineering, landscape architecture, architecture, sociology, law, and economics and finance. In view of the contributions of political science and geography in the study of cities in Germany, France, and the United States, one wonders why no mention was made of those fields.

Dr. Adams' book is restrained in its claims for his profession. It puts the case in scholarly fashion, largely leaving the reader to reach his own conclusions. The volume is not completely documented. The included documentation, however, is of such high quality that the reader wishes a more complete effort had been made in this respect. The illustrations are excellent and in themselves constitute a fine record of city planning.

In a discriminating bibliography Katherine McNamara continues the record contained in the earlier "Manual of Planning Information" by Theodora Kimball Hubbard and herself (see also Theodora Kimball: Manual of City Planning and Zoning, 1923). This present bibliography is Volume 10 of the studies of the Harvard City Planning School and takes high rank in this scholarly series. In addition to the bibliography proper, the present volume contains a brief planning bookshelf made up of the outstanding planning publications, a well selected short list of typical state and regional planning reports, a review of the organizations active in promoting

planning in the United States, a list of periodicals devoting space to planning, and a brief survey of planning publications in other countries.

The arrangement of the main bibliography emphasizes the more important divisions of the planning literature. One section deals with the composition of city plans, another with the elements of city plans, and still others with types of city plans, regional planning, and state and national planning. This scheme of classification segregates the materials of each phase of planning and also facilitates a rapid survey of the whole planning field. It should be emphasized that Miss McNamara presents a selected bibliography rather than a complete listing of titles. As might be expected, the bibliography is more thorough in the planning phases than in the strictly scientific phases of urbanism. Likewise it is much less thorough in covering the materials in French and German, especially the latter, than in English. The volume, nevertheless, is so comprehensive in scope and so well arranged that it should be of large service to everyone interested in urban areas and civic problems.

CHARLES C. COLBY

THE STORY OF HUMAN PROGRESS

V. GORDON CHILDE. **Man Makes Himself.** xii and 275 pp.; map, diagrs., ills., bibliogr., index. (The Library of Science and Culture No. 5.) Watts & Co., London, 1936. 7s. 6d. 8 x 5 inches.

While this book is not geographical, in fact rarely mentions the word, it should interest the geographically minded, because that term is coming to mean not a fixed but a changing environment. It is quite probable that the first aboriginal Indians in Ohio, for example, found themselves in a country of coniferous trees instead of deciduous forests—a circumstance to be taken into account when interpreting the corresponding aboriginal cultures. So in sketching the career of man, in general, the author of the book under review takes for granted that the Great Ice Ages of the Old World were but peaks in a fluctuating human environment that is still changing. He emphasizes that none of these drastic changes in environment came suddenly but so gradually that man was never aware of them. It is the ultramodern man who keeps records of such things, but even he looks upon the matter as academic. However, Dr. Childe's book is not merely a brief survey of man's career in this changing world but an interpretation of human achievement.

The author frankly asserts that he accepts the concept of progress in so far as it represents time sequence and the accumulation of experience. He is not greatly interested in social values nor race group superiorities but cites the biological concept that the superior species is the one showing a high survival rate. This would dispose one to look on modern life as superior, since we now have dense populations in contrast with tiny scattered settlements in primitive times. However, the author regards the long culture career of man as expressible in at least four great revolutions: the food gatherers, neolithic farmers, city dwellers, and those who live by science; these terms are not exactly as used by the author but may convey his meaning. His idea is that each of these so-called revolutions represents basic changes in economics and society. Being an archaeologist, he stops short of what is known in modern history as the industrial revolution.

In the food-gathering stage small groups of hunters and foragers slowly improved their techniques and implements. There was next to no political organization. A few basic inventions were made, as fire making, the spear thrower, twisting string, chipping stone, drawing and painting. Fire was probably the greatest achievement. Thus primitive man kept adding to his store of knowledge for more than a hundred-thousand years. Then eventually and gradually in restricted localities, agriculture and stock raising evolve, making possible villages of farmers, who with stores of food begin to improve their housing, devise pottery, begin work in metals, invent the cart,

use oxen, and ride horses and camels. Villages were still small, but now more numerous, since several times as many people could survive in a given area. There were no great nations, but some of the wilder hunters found it easier to raid than to farm; many did both.

This new kind of life seems to have prevailed for some 2000–4000 years, but beginning at about 3000 B.C. the archeologist finds the ruins of large towns and even cities, indications of what the author regards as the urban revolution. Now the self-contained villages of neolithic times are caught up into a new political organization and subjected to the city, furnishing it food and raw materials. Thus trade develops on a large scale, conquest becomes the chief means of expansion; in short, the monarchy evolves simultaneously in three countries, Egypt, Sumer, and India. Of course population expands rapidly. Under this regime there is a diversification of crafts, but the chief changes are in government, the army, and society. Priests, rulers, subjects, and slaves are now clearly differentiated.

In turn the undoing of the great monarchies came about because, while the priests intensified their rule by fear and superstition, some of their subjects were increasing their store of knowledge and their practical experience. The monarch with his armies and his highly organized economy, is obliged to encourage the technicians, especially those skilled in writing and measurement. Thus the scribes and the calculators rose to power, spurned production, and became the first "white collar" class. They were the antithesis of tradition and mysticism, they dealt with stubborn realities, they were the interpreters of the principles of the crafts, they sought new and certain methods of finding out. This the author believes underlies the new revolution in knowledge.

This crude outline of a brilliant book necessarily omits all the stimulating detail, insight into social change, and new historical correlations that enliven the successive pages (for a more extended outline see "Human Progress: a review" by O. G. S. Crawford, *Antiquity*, Vol. 10, 1936, pp. 391–404). The author disarms criticism by citing the incompleteness of the archeological record and the uncertainties in his imaginative flights of interpretation. Nevertheless his statements are conservative, as becomes one of the world's great archeologists, and should give the reader an understanding of man in the making. We regret that the discourse stops short of the present because the vista of the past cannot be integrated with modern life.

CLARK WISSLER

METEOROLOGY FOR THE LAYMAN

DAVID BRUNT. **Weather Science for Everybody.** xii and 170 pp.; maps, diagrs., ills., index. (Changing World Library.) Watts & Co., London, 1936. 2s. 6d. 7½ x 5 inches.

Professor Brunt's contributions to meteorologic science have been concerned with the complicated physical problems presented by the atmosphere. It is therefore no accident that the parts of this little book that deal with radiation, the physics of the free air, and water vapor in the atmosphere are the ones that show the freshest viewpoints and convey the most penetrating insights. They bear those marks of creative understanding that every reader, lay or professional, looks for eagerly and finds all too rarely in popularly written scientific books. Other chapters, entitled "Weather Observations and What They Mean" and "The Weather Map and the Weather Forecast," give in a workmanlike manner such information as the layman needs in order to appreciate the operation of a public service he generally knows only through its final product, the weather forecast. The chapters on climate, although also workmanlike, contain no fresh materials or interpretations.

Three out of fourteen chapters are devoted to relations between weather or climate and human affairs. These are disappointing, though a wholehearted reservation to

that judgment is to be made with reference to the good discussion of the exchange of heat and water between the human body and the air—an almost purely physical problem, it is to be noted. The meteorologist, unless he works with cultural and historical material very cautiously indeed, is likely to become involved in difficulties when he tries to relate it to the proper content of his science. Brunt falls victim to this peril, most lamentably, in his first chapter, "Weather and Human Affairs in Peace and War." Here he is obviously slogging through an utterly unfamiliar morass; the reader is enormously relieved (and the author must have been, too) to get that behind him and to step out on the solid ground of physical meteorology that Brunt knows thoroughly and can present concisely and instructively.

JOHN LEIGHLY

LIFE OF PEARY

WILLIAM HERBERT HOBBS. **Peary.** xv and 502 pp.; maps, diagrs., ills., index. The Macmillan Company, New York, 1936. $5.00. 9½ x 6½ inches.

Professor Hobbs' book on Peary is not an ordinary biography, since it appears to have been written with two definite objects in mind: to eliminate for the future all doubt as to Peary's attainment of the North Pole, and to make the readers understand the great explorer, perhaps to make them admire him and love him as the author does.

The author has accomplished his first object completely. When describing Peary's earlier expeditions he builds up confidence in the endurance and tenacity and the eminent leadership of the explorer, and in doing so he uses his own judgment based on extensive knowledge of the Arctic. He has succeeded in giving a consecutive, complete, and vivid account of Peary's journeys across the Greenland Ice Cap, along the coast of the frozen Arctic Sea, and across the treacherous sea ice. The story of Peary's explorations is full of dramatic episodes and thrilling adventures, and of tales of success and defeat. But whether successful or defeated, Peary went on, ever aiming towards more and more distant goals.

Against the background of previous sledge journeys, many of which were more trying, more dangerous, and more exhausting, Peary's final dash to the Pole appears as the self-evident crowning accomplishment, based upon years of crucial experiences. The author disposes easily of the most severe criticism that was directed against Peary. It was claimed that his marches on the return from the Pole were unreasonably long, but Hobbs shows that the length of the return marches, relative to the forward marches, was the same in the case of the Polar Party as in the cases of the supporting parties.

But will Hobbs succeed in giving Peary a place in the hearts of his countrymen, the popularity which he never reached in life? I doubt that, since in order to understand Peary one must know why he was not popular, and Hobbs gives no reasons.

I never knew Peary, but I have known other men of similar accomplishments. It has struck me that they have been utterly self-centered, have considered themselves as having a special mission in life, have been unable to understand the lack of public sympathy in their enterprises and unable to play up to the public because they took it for granted that the goal of their ambitions was all-important. It appears as if Peary was perhaps more self-occupied than most others. This feature of his character, his greatest strength in his life work, was his greatest weakness in his relations to the public. The younger generation, which does not know Peary, would perhaps have a greater sympathy for him and a better understanding of the relation between him and the public if his self-centered outlook had been boldly underlined and not concealed between the lines. Perhaps Hobbs could have shown us an even more rugged Peary, but the undaunted explorer could not have been described better.

H. U. SVERDRUP

AMERICAN GEOGRAPHICAL SOCIETY

Officers and Councilors for 1937

Honorary President

JOHN H. FINLEY

President

ROLAND L. REDMOND

Vice-Presidents

PHILIP W. HENRY
Term expires 1938

OLIVER B. JAMES
Term expires 1939

W. REDMOND CROSS
Term expires 1940

Domestic Corresponding Secretary

PAUL TUCKERMAN
Term expires 1938

Foreign Corresponding Secretary

FREDERIC C. WALCOTT
Term expires 1939

Recording Secretary

HAMILTON FISH KEAN
Term expires 1940

Treasurer

HENRY PARISH
Term expires 1938

Councilors

ISAIAH BOWMAN — F. TRUBEE DAVISON — JOHN H. FINLEY
CARL C. SHIPPEE — WILLIAM A. ROCKEFELLER
Terms expire 1938

LINCOLN ELLSWORTH — H. STUART HOTCHKISS
ARTHUR CURTISS JAMES — FRANK L. POLK
Terms expire 1939

PHILIP A. CARROLL — CHARLES R. CRANE — WILLIAM HALE HARKNESS
ARCHER M. HUNTINGTON — WESLEY C. MITCHELL
Terms expire 1940

Secretary

Raye R. Platt

Editor of the Geographical Review

G. M. Wrigley, Ph.D.

Contributing Editors

Harlan H. Barrows, Pd.M., The University of Chicago
H. J. Fleure, D.Sc., The University of Manchester
Ellsworth Huntington, Ph.D., Yale University
Mark Jefferson, A.M., State Normal College, Ypsilanti, Mich.
W. L. G. Joerg, The National Archives, Washington, D. C.
Douglas Wilson Johnson, Ph.D., Columbia University
H. A. Marmer, U. S. Coast and Geodetic Survey, Washington, D. C.
Lawrence Martin, Ph.D., Library of Congress
Robert Cushman Murphy, D.Sc., American Museum of Natural History
Alan G. Ogilvie, M.A., B.Sc., University of Edinburgh
Carl O. Sauer, Ph.D., University of California

OBJECTS OF THE SOCIETY

The objects of the American Geographical Society are to collect and disseminate geographical information by discussion, lectures, and publications; to establish in the chief city of the United States a place where may be obtained accurate information on every part of the globe; and to encourage such exploring expeditions as seem likely to result in valuable discoveries in geography and the related sciences.

The American Geographical Society is the oldest geographical society in the United States. When it was founded, in 1852, there were but twelve similar societies in the world. Now it exchanges publications with more than four hundred scientific associations. The Society publishes the *Geographical Review*, a quarterly magazine issued in January, April, July, and October, and a *Research Series* of comprehensive scope. It has also a large and growing library—one of the most important geographical libraries of the world; thousands of maps and charts; and a remarkable collection of atlases of the sixteenth, seventeenth, and eighteenth centuries.

Travelers, men of science, and others properly accredited are welcome at the rooms of the Society and may freely use the book and map collections.

Three gold medals have been founded by the Society, the *Cullum Geographical Medal*, the *Charles P. Daly Medal*, and the *Samuel Finley Breese Morse Medal*, which are awarded from time to time to explorers, writers, and men of science who have contributed to the advance of geographical knowledge.

In addition it awards the *David Livingstone Centenary Medal*, founded by the Hispanic Society of America.

The qualifications for fellowship are an interest in exploration and travel, in the spread of geographical knowledge, and in the advancement of science.

A Fellow is entitled to the use of the library, reading and map rooms; to admission to all lectures and exhibitions; to the *Geographical Review;* and to occasional books and maps distributed by the Society.

The annual dues are ten dollars.

Form of Bequest

*I do hereby give and bequeath to the American Geographical Society of New York*_____